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# ELECTRICAL REVIEW.

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## MENTAL EFFICIENCY.

MUCH has been heard during the last few years of the value of brains in industry. Like the noble lord in "Iolanthe," people have the greatest respect for brains, and often wish they had some themselves. It is worth while to consider what is meant by the expression, and to endeavour to present a clear idea of what there is about the brainy man that makes him different from his neighbour. Worldly success is not necessarily a measure of braininess. Mere capability in the execution of some particular work is not always reliable as an indication of that quality. There must be a breadth of vision, an adaptability to new ideas, a faculty of imagination, in the leader of men. He must be able to make progress as well as to do the best there is to be done at the present time.

At a Conference held by the Imperial Education Committee of the War Office, recently, there were discussed the problems which had arisen in the operation of the educational schemes adopted in the Armies of the Empire, and on June 12th the subjects discussed at Australia House were:—"Education to Meet Specific Technical and Commercial Needs within the Empire"; and "Co-ordination of Research and Distribution of Information as to the Technical and Commercial Needs of the Empire." The chairman of the meeting, Sir Henry Hadow, recently appointed to the Vice-Chancellorship of the University of Sheffield, opened the discussion, and was followed by Mr. J. C. Maxwell Garnett, Principal of the Manchester College of Technology; Mr. A. P. M. Fleming, O.B.E., manager of the Research and Education Department of the British Westinghouse Co., Ltd., Manchester; Major Stallard, of Johannesburg; Sir William Ashley, Vice-Principal of the University of Birmingham; Sir Frank Heath, secretary to the Department of Scientific and Industrial Research; Prof. Boyle, of Alberta; and Lord Bledisloe, better known as Sir Charles Bathurst.

The chief points that seem to emerge from the discussion are that preliminary education must be wide and general, that specialisation must follow, that specialisation in commercial training has been overdone, and that special education, not merely of a technical kind, is required to make the best heads of departments.

It is, perhaps, more necessary in the consideration of educational questions than in any other case, to get the proper perspective of the whole subject, and not to get so close to it that it becomes impossible to see the wood for the trees. It is clearly impossible that an individual should specialise first in one direction and then in another until he has an expert knowledge of everything he is ever likely to meet with in his career. Life is too short, for one thing; and it is unlikely that any person would ever be able to come from an educational establishment, whether of the character of a university or not, fully equipped to take immediate charge of, say, a department concerned with the design, or manufacture, or sale, of steam turbines. Training for the higher administrative positions is best acquired by experience in some (not all) of the lower. Education of this nature never comes to an end. General education prepares the ground; special education determines the choice of a career—determines the particular form in which the individual can best render service to mankind; and the power of observation, retention, and adaptation of knowledge to the purpose in hand must constantly be cultivated. But when Sir Henry Hadow tells us that at Newcastle the

student in arts has to take a course of lectures in science, and *vice versa*; when Mr. Fleming associates himself with Mr. Garnett in calling for men who are well educated as heads of departments, and not merely technically; when Sir William Ashley states that an economic training is wanted for all business men; why, then we begin to wonder whether what is wanted is not a higher, better, and more efficient standard of general education. After all, it is the general manager who runs a business, and his trained experts assist him to do it.

The duty of the community in matters of education is, to see that every individual has a real opportunity of access to such facilities as will bring out his full measure of capability and general usefulness; and for this purpose to increase the number and value of scholarships that are available until this duty is fulfilled, and no-one finds that the accident of poverty keeps him in the background all his days. Private munificence might assist this aim, and memorial scholarships could frequently be made a matter of public subscription, as in the case of the late Sir William Ramsay. Students from technical colleges and other educational institutions might be asked to subscribe towards memorial scholarships for professors who have materially helped them. There ought to be a Silvanus Thompson memorial scholarship at Finsbury, an Ayrton Memorial at South Kensington, and so on. Scholarships can never be overdone; and while wealth continues to be distributed as unequally as at present, they form practically the only means of helping forward the masses of the people, and bringing out the talent which is a heritage of both rich and poor.

## SUPPLY COMPANIES AND THE BILL.

Share prices in the list of London Electricity Supply Companies were unaffected by the introduction of the Government's Electricity (Supply) Bill, 1919; but, on the second reading of the Bill, a nervous tendency developed which led to sales, and, therefore, to a general weakening of quotations. The full influence of the movement is worse than the prices reflect, because at times of late it has been none too easy to realise shares at any but the lowest-quoted levels. This proved the more disappointing to holders in that a hope was raised in some quarters as to a possible extension of the companies' tenure of life, as one result of the Bill; and as, for twenty years past, the share market had been overcast by uncertainties as to how the purchase clause of the Electric Lighting Act, 1888, would be interpreted in 1931, when the clause became operative, anything which promised relief in this direction must be obviously a "bull" point from the point of view of the investor, to whom uncertainty is anathema, and insecurity a bar. This point—*i.e.*, the chance of the purchase clause being relegated to the limbo of a longer future—is not lost sight of, but other factors were regarded as so much more pressing, and depressing, that market firmness rapidly evaporated, being replaced by the weakness now obtaining. It is an unlucky coincidence that the new Loan campaign should have been simultaneous with the fears of the Governmental alteration of the Lighting Companies' concessions. When investors are turning out their strong boxes to see whether there is anything they can realise in order to raise money for subscription to a National Loan, they are liable to throw out securities which do not happen to be popular at the moment, and over the prospect of which uncertainty hangs pendulous.

In the early part of last week, certain of the undertakings issued a "memorandum for the consideration of shareholders in the London Electric Supply Companies." Covering letters were sent in some cases. The Kensington and Knightsbridge letter may be quoted. "The directors," it says, "have given careful consideration to the provisions of the Bill; many clauses, which they view with great concern, are detrimental to our general interests." Shareholders are urged to request their "Parliamentary representative to support such amendments as will protect the existing rights and legitimate interests of shareholders." That memorandum attacks in no measured terms the leading provisions of the Bill. It has literally no good thing to say for it. The Bill, according to this memorandum, violates and disregards Parliamentary bargains made with the companies. It is unfair and inequitable. It provides for the shortening of the companies' tenure as regards part of their undertakings, and for the piecemeal taking away of their properties. Instead of the "fair market" value of the property at the time of purchase, as laid down in the Act of 1888, the companies under the 1919 Bill are to be paid the "standard price." While depreciation is to be allowed in arriving at the standard price, no allowance is under any circumstances to be made for appreciation.

These are the main lines of a memorandum which, to speak candidly, over-presented the companies' case, and which, by its silence as to any good points of the Government Bill, proved disconcerting and disquieting to shareholders. Not all the latter perceived that the memorandum was so manifestly a piece of special pleading as to induce the impression that even its authors did not desire it to be taken too seriously. Possibly with the intention of pouring oil upon over-troubled waters, the directors of the County of London Electric Supply Co. issued, three days later, a circular-letter of milder tenor altogether. Assuming that shareholders will naturally wish to know the views of the board with regard to the Bill, the directors boldly declare that they welcome the main principle. In their opinion, however, the Bill as drafted is cumbrous, unworkable, and likely to paralyse rather than stimulate the development of electricity supply. It is stigmatised as most unacceptable, in that its provisions ignore the Parliamentary bargains of 1888 and 1908, are not in the public interest, are inequitable, and so on. The County Co. prints, however, quotations from the Home Secretary's speech in introducing the Bill on its second reading, when he assured the House that the Government, in endeavouring to provide cheap power, desired "no avoidable hardship to any of the pioneers to whom we are so indebted, doing what is fair, we hope, to all." As to the standard price fixed by the Bill, "the intention," said the Home Secretary, "is that a fair price, having regard to all the circumstances, should be paid."

This is a recapitulation of the position, as it stands at the time of writing, of the events over the past six weeks. Stock Exchange interested circles look on with keen attention. Interchange of views brings out a fairly general conclusion that the Bill, with amendments, will be a useful one in the public interest, and that quite possibly shareholders are not likely to suffer much through its passing into law.

**Thermionic Currents.**

The paper read by Captain L. B. Turner before the Institution of Electrical Engineers, on Monday last, was noteworthy in several respects. It was read at a season when the Institution, as a rule, is, to all outward appearance, on holiday—yet it attracted a full attendance, and elicited an interesting discussion; it was the third of the series of papers on wireless telegraphy which has amply justified the policy of the President in inaugurating a Wireless Section of the I.E.E.; and it was in itself a model of what such a paper should be—concise, yet complete, lucid, restrained, and, what is only too rare in engineering proceedings, of high literary merit. The admirable and entirely successful demonstrations with which it was accompanied were not overdone, and the reading, in abstract, was well done.

The vacuum valve, or "triode," is one of the most marvellous achievements of electrical science; it has rendered possible feats which could hardly have been

conceived even five years ago. Originating in purely scientific research, it has been developed amazingly by technical research, and in itself constitutes a convincing proof of the necessity of carrying on both classes of investigation simultaneously and thoroughly. So striking and revolutionary are its capabilities, that it compels us to question whether the hackneyed saying that "Electricity is still in its infancy," is not, after all, fully justified; for if, even at this stage of development, such fundamental departures from the commonplace can still be made, it may be, and probably is, the fact that even more unexpected and momentous discoveries remain to be effected.

It is not many years since the invention of an ultra-sensitive detector for wireless waves, of a calling-up device for the same purpose, of a satisfactory distortionless telephone relay, of a high-pressure rectifier, of a device for intensifying telephone currents, of a generator of high-frequency oscillations, was eagerly desired; all these functions, and many more, are fulfilled by the triode in some form or other, with extraordinary efficiency. Captain Turner showed that his relay, operating with a power of one-hundredth of a microwatt, was 500,000 times as sensitive as the ordinary Post Office telegraph relay, and that the energy required to trip a P.O. standard polarised relay was one million times as great as for the valve relay.

We cordially welcome this paper for a different reason altogether. Hitherto the British authorities have been exceedingly chary of permitting the publication of the details of the wireless apparatus developed during the war, and for such information we have had to go to American sources, upon which we have drawn freely. But the inevitable tendency of our British policy of secrecy and the American policy of publicity is to transfer much of the credit for the excellent progress achieved to our American friends, an obvious injustice to our own workers. That is not our fault—we must keep our readers informed as far as possible on all new developments. But we would vastly prefer to derive such information from home sources, and we trust that the policy of silence which, necessary during the war, has been maintained in peace time, is now to be abandoned.

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**The Contractor's Difficulties.**

It is surprising what a lot of nonsense is being talked about the shortage of houses for the working classes. People who complain of lack of enterprise on the part of local authorities and builders forget that owing to the exigencies of the war, Parliament was constrained to prevent works of construction of any magnitude being commenced unless with the consent of the Ministry of Munitions. Nor was it a light thing to assume that it was unnecessary to obtain that consent. A recent case (which is reported in the *Law Times Reports*) affords a striking illustration. A contract to effect certain improvements and repairs was entered into. No definite sum was mentioned, but it was expected that the work could be done for about £1,500. Subsequently the well-known order under D.O.R.A. came into operation, rendering it necessary for a licence to be obtained. A licence was granted to do the work at a total cost of £1,350 approximately. Operations were begun. Wages rose, materials became more costly, and further work, including a new roof, was found necessary. This was carried out. In the result the total cost amounted to £2,671. The architect certified that the whole of this amount was due. The building owner paid £1,350, but refused to pay the balance, on the ground that the work in respect of which it was claimed was outside the licence granted by the Minister of Munitions, and was illegally performed. In the course of a long judgment, Mr. Justice McCardie found that the building owner was entitled to succeed in an action brought against him. He had his house improved at an agreed cost of £2,671, but was held liable for £1,350 only. Quoth the judge: "They (the builders) were knowingly taking part in an illegal transaction, and they cannot, I think, recover the sums claimed in this action." Here, then, is one reason why builders have been a little shy of undertaking any large operations during the last few years.

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**The Indian Society of Engineers.**

The need of a "Society for the advancement of all branches of engineering science in India" has long been felt; hitherto there has been no one organisation to which engineers of all branches could turn for the exchange of technical information and for social intercourse, though numerous engineering societies are amply represented in that great Empire. The impossibility of maintaining a separate organisation for each Society is obvious when it is borne in mind that the members are dispersed over so enormous an area, and earlier attempts to do so have been, to a great extent, unfruitful. A satisfactory alternative has, however, been found in the incorporation of all engineers, irrespective of their specialist functions, in one all-embracing society. The subject was brought into prominence in December last by a preliminary general meeting in Bombay, but the matter had been simmering for several years; efforts had been made to induce the Home engineering institutions to take joint action, but, unfortunately, while they expressed sympathy with the proposals before them, they with one accord threw cold water on the idea of complete co-operation between the members of the three great Institutions in India. Under the chairmanship of Sir Thomas Holland, and with the strong support of Mr. A. C. Coubrough, Major G. H. Willis, and Mr. J. W. Meares, the formation of the new society was resolved upon unanimously, and an organising committee was appointed. Rules were drafted, and a constitution was drawn up which provided for the formation of local associations at suitable centres; a high standard of qualifications will be maintained, and members of British and Allied engineering societies of approved standing will be admitted. The movement is warmly supported by the Indian Government, which, it is believed, will make membership of the Society a condition of appointment to posts under its control, and the membership of the Society is growing at a phenomenal rate.

A guarantee fund of Rs. 30,000 was readily raised at the very commencement, and we understand that ten times that sum would at once be forthcoming if required; the subscriptions are, for members, Rs. 15, and for associate members Rs. 12, per quarter. The Society aspires to obtaining a Royal Charter of Incorporation, with the aid of the Government of India, and will probably in no long time become a power in the land; it will be able to afford most valuable assistance to the Government as an advisory body on questions relating to technical education, engineering schemes, regulations, &c.

One of the most prominent founders of the Society is Mr. E. M. Hughman, hon. secretary in India of the Institution of Electrical Engineers; Mr. Hughman was appointed hon. organising secretary, and consequently the bulk of the work fell on his shoulders, until he recently came to England on leave. Major H. W. Brady is his successor, and, as one of the original members of the Manchester Engineers' Club, and its first hon. secretary, he is well versed in the factors of success. The new Society will deal with all matters pertaining to the advancement of engineering science and the promotion of the welfare of its members, and will take steps to standardise engineering materials on the one hand and engineers' salaries on the other. It will undoubtedly be of immense benefit to engineers in India, and its ultimate development can hardly be assigned limits.

# ELECTRICITY SUPPLY AT SHANGHAI—EXTENSIONS.

The programme of generating plant extensions recommended in the report abstracted below, dated December 6th, by Mr. T. H. U. Aldridge, engineer-in-chief and manager of the Shanghai Municipal Electricity Undertaking, and approved by the Electricity Committee, has been endorsed by the Council.

In his report to the Committee presented last year, which led to the ordering of the 18,000-kw. turbo-generator and other plant in the United States, Mr. Aldridge outlined the general proposal indicating that the 18,000-kw. machine would be erected in the original (1913) portion of the Riverside power house. The machine was to be placed in the position now occupied by the two A.E.G. 2,000-kw. machines. At the time this report was made it was anticipated that both the 10,000-kw. Parsons and the 5,000-kw. Fraser & Chalmers' machines would have been delivered, erected, and put into commission long enough before the arrival of the 18,000-kw. machine to allow of the removal of the A.E.G. sets and their foundations, but the non-delivery of the Parsons set makes it inadvisable to scrap the A.E.G. machines for the present. The electrical generators of these two machines have broken down to such an extent that the repairs cannot be undertaken by the department. It is hoped that it will be possible for them to be reconstructed in Japan, and if completed during the next year it will be advisable to retain the machines as stand-by and for meeting peak loads. In these circumstances the proposals which the engineer now makes are as follows:—The reconstruction of the generators of machines Nos. 1 and 2, and their retention for a few years on their existing foundations in the 1913 section of the power house. The erection of the two 2,000-kw. Willans turbines in a temporary building. The two 18,000-kw. machines to be installed in a new extension of the turbine room, which will form the nucleus of an entirely new addition to the power house.

It may not be necessary to order the boilers at the same time, or, at least, not the whole of the boilers which will ultimately be required for the new boiler house, which must be designed to contain boilers sufficient to provide a complete boiler house unit for 36,000 kw.

With the installation of the second 18,000-kw. machine, the present limit of the site will be reached. The next step will be to remove all the A.E.G. turbine plant, amounting to 14,000 kw., and in the space released to install another 18,000-kw. unit, retaining the 1913 boiler plant for supplying it with steam. Then may come the time to erect a second power station on the recently acquired adjacent property, complete with turbine, boiler, transformer, switchgear, and coal-handling plant.

In the past it has been found that the demands have overtaken the various extension programmes, and the department has really never caught up to the position of being able to operate with a safe margin. It will be seen from the foregoing that the ultimate demands for electricity supply in Shanghai and its neighbourhood cannot be foreseen. The extensions outlined do not by any means cover the ultimate possibilities of Shanghai's electrical requirements; they should not be looked upon as approaching the ultimate capacity of the undertaking.

Figures given in the report set out in detail the estimated increase of demand up to 1924, together with the suggested sizes of plant units to meet this:—

| | Plant capacity in kw. | Estimated demand in kw. | Safe load in kw. with allowance of spare plant. |
|---|---|---|---|
| 1919 ... | 38,000 | 29,000 | 27,000 |
| 1920 ... | 79,000 | 34,000 | 26,000 |
| 1921 ... | 65,000 | 39,000 | 42,000 |
| 1922 ... | 83,000 | 45,000 | 60,000 |
| 1923 ... | 83,000 | 53,000 | 60,000 |
| 1924* ... | 83,000 | 58,000 | 60,000 |
| or | 103,000 | | |

Summarised, the advantages of duplicating the General Electric machine are, in the order of importance, (1) valuable saving of time in constructing the power-house extension and carrying out a complete extension scheme immediately, and (2) interchangeability of parts. The advantage of (1) being able immediately to carry out the power-house extensions forms an argument in favour of placing the contract as recommended. It is reasonable to assume that if the G.E.C. plant is in commission at least six months earlier than if the order is placed in London, there will also be a gain in operating conditions, because for every month this new machine is on load there should be a corresponding saving in the coal consumption beyond that obtainable with the plant recently installed under the 1916 extension scheme. Moreover, it will enable the department to scrap the 14,000 kw. of A.E.G. plant in 1920 or 1921, and give time to clear out their foundations and prepare for the installation of another 18,000-kw. set in the space so released in the 1913 part of the Riverside power house. It will, furthermore, make it possible to postpone the erection of the second power house on the new property until a later date, and generally would be more economically sound in the long run.

Part III of the report details the generating plant, switchgear, transformers, and cables which should be ordered to provide adequate means of meeting the demands for electricity during the period 1919-21.

From the annual report for 1918 on the working of the department, it appears that the past year was an anxious one, although the conditions were not so bad as in the two previous years. The worst corner has been turned, and from now onwards the conditions under which the department has laboured—due to shortage of plant—should be materially improved. The works cost per unit sold and accounted for has increased exactly one tael cent; repairs and maintenance also show an upward tendency. Coal per unit has risen from 1·38 to 2·06 cents, due to the price having increased 77·6 per cent., but, in face of this, the actual coal used per unit sold has been reduced, and was, as a matter of fact, the lowest yet recorded by the combined stations. The installed plant capacity of the two stations at December 31st last was 31,600 kw.: Riverside, 26,000 kw., and Fearon Road, 5,600 kw. To the first-named station will be added one 5,000-kw. Fraser & Chalmers turbo-generator (erecting), one 10,000-kw. Parsons, and two 18,000-kw. G.E.C. turbo-generators (building).

The maximum load which occurred simultaneously at the two stations was 22,012, and the load delivered to feeders, 21,122 kw. But for the lighting restrictions the maximum load would have been about 500 kw. greater. The load-factor has risen to 46·77 per cent. It is the highest figure yet reached by this undertaking, and indicates the preponderance of power and traction supply. Total units generated at both stations amounted to 106,045,021, of which Riverside accounted for 100,298,500, and Fearon Road for 5,746,521. Total units sold amounted to 86,275,659, an increase of 9·91 per cent. over 1917; private lighting, 14,444,261, minus 761,758; public lighting, 1,141,973, plus 13,077; heating and cooking, 899,852, minus 229,902; power, 66,024,895, plus 8,842,555; traction, 3,764,678, minus 78,755.

The falling-off in lighting is attributed to the discontinuance of outside and advertising lighting (loss of 900,000 units), restrictions on new consumers' installations, and the economy exercised by consumers since the price was raised. The falling-off in units sold for heating and cooking was due to restrictions on the installation of additional radiators, and to the increased price of energy for heating purposes, now 60 per cent. above the original rate. Little advance in this line was possible due to plant shortage, but given a sufficiently low rate per unit, the success of the heating business is assured, and it is looked upon as a valuable asset. Some success was obtained in heating water by electric water heaters, and it is believed that this feature will also figure prominently in the future.

During the year 100 miles of overhead cable was erected; 1·98 miles of E.H.T. underground mains; 2·05 miles of L.T.; and 1·45 miles of underground public lighting cable was laid. The efficiency of distribution is now 86·9 per cent. Considerable alterations and improvements were made in public lighting. Reliable data concerning the

* If the load increases more than estimated it may become necessary to have the first part of the second power house on the adjacent land completed, and have available additional generating plant in 1924.

useful life of nitrogen-filled metal-filament lamps have been obtained. The average life obtained from street lamps locally is 5,200 hours, *i.e.*, about 15 months' service. The net increase for the year in transformers was 9, or 3,870-KW. capacity; in sub-stations, 4; and in pole transformers, 2; the grand totals at the end of 1918 being: sub-stations, 66; pole transformer stations, 14; transformers, 114; capacity of transformers, 34,287 KW. New motors connected during the year totalled (net) 253, or 4,381 H.P., the grand total being 1,779, or 27,720 H.P. The most noteworthy feature of the year's working was the manner in which the demand for motors was maintained by the smaller consumers, in spite of the prevailing adverse conditions. This fact was responsible for the increase of 10 per cent. and 27 per cent. respectively in the number of motors connected and their total H.P., as compared with the previous year's results.

The net profit on the year's working, after providing taels 449,903 for depreciation and taels 390,535 for interest, was taels 302,138, against an estimated taels 433,919. That the profit has not reached the anticipated amount is attributed to the falling-off of lighting units sold, which was due to the causes already explained in another part of the report. The estimates for 1919 indicate a profit of taels 332,123, after providing taels 516,000 for depreciation, and taels 536,401 for interest. In June, 1918, the sum of taels 364,000 was paid over to the Council's general funds from the profit of 1917.

The European staff of the undertaking now numbers 79, and the Chinese 1,198.

## MOTOR-DRIVEN VENTILATING FANS: SOME CRITICISMS.

BY S. LEES.

BREAKDOWN of electric motors due to failure of integral ventilating fans is a common source of trouble, especially with alternating-current type machines. Defective design is directly responsible in the majority of such cases of failure, while not a few can be attributed to faulty workmanship, and collapse of fans arising from lack of proper knowledge of the electro-mechanical conditions obtaining is of frequent occurrence.

A fact which does not seem to be appreciated by a good many designers of electric machinery is that the mechanical movement of air has now become a highly specialised branch of engineering. Fan design being a complicated scientific process involving an intimate and practical understanding of wind mathematics is, therefore, rather outside the scope of the average electrical engineer designer.

Many so-called self-ventilating motors are provided with fans weakly designed and fitted in such a manner as to be positively harmful, as for instance a certain make of A.C. motor having an impeller attached at each end of the rotor. A veritable wind-jammer; this particular form of fan actually produces air pocket, and, in addition to being a useless accessory, it sooner or later becomes a source of danger to the working of the machine, owing to an unmechanical method of fixing the runner. An otherwise excellent type of A.C. motor, the product of an eminent firm, is seriously marred by a badly-designed fan. The form of impeller or runner in question is designed somewhat on the lines of a cased medium-pressure fan, such as is used for boiler draught, forced ventilation, &c. The multi-blades are attached to a shroud-ring of robust construction, but the back or carrying-plate—a mild steel stamping of the same thickness as the shroud-ring but thinner than the blades—is perforated, presumably for lightness, to a dangerous degree. The method of attaching the fan to the rotor casting is extremely crude; the back plate is pierced at four equi-distant points pitched very close to the shaft hole, and four corresponding studs screwed to the rotor casting carry the fan runner. Note that no hub, boss, or stay of any kind whatsoever is provided—an omission which not even a third-rate fan maker would be guilty of. The enormous centrifugal stresses set up in an already improperly balanced runner quickly cause buckling of the back plate, the stud holes become eccentric, and the studs get sheared until ultimately total collapse occurs unless preventive measures are adopted. An example of the form of fan under review is before the writer. Obviously caught just before collapsing, the stud holes are elongated to twice the original size, the studs being practically cut through. The runner could be withdrawn without removing the studs owing to the enlarged state of the holes in the back plate. Incidentally, the winding of the motor was badly damaged by the loose fan striking the stator end turns.

An illustration in proof of the statement made at the beginning of this article is found in the case of a certain well-known make of machine. The fan consists of a solidly-built iron casting as in a 20-H.P. unit weighing some 10 lb. average—of the spoked-wheel pattern. Sheet steel vanes bent at right angles are attached by rivets to the rim of the wheel, no shroud-ring or stays being provided. To properly balance a fan runner of this description is practically impossible, and trouble inevitably ensues; this may occur in one or both of two ways. The vanes sooner or later work loose due to the imperfect method of attachment to the rim of the runner. The effect of magnetic leakage produces distortion of the vanes which ultimately break, along the inside of the bend usually. Another similar type of machine by a different maker also comes in for very casual treatment in the matter of the fan fitment used. A number of angular pieces of sheet steel each held by one ridiculously small set screw are secured to convenient points at the ends of the rotor casting. Closely akin is yet another type of machine having only one fan vane at each end of its rotor. Note the utter inconsistency in balancing mechanically a rotor so fitted, the whole calculation of which will, with almost a certainty, sooner or later be upset. That a machine bearing a name should be turned out with such miserable attachments as above described would seem to pass comprehension. Unfortunately, however, such is the fact. Motors fitted with this kind of apology for ventilating fans are being marketed at the present day. In a typical case of recent failure, a motor of the type referred to had nine out of the twelve vanes constituting its fan broken off. The detached pieces were scattered in all directions inside the machine, and one of the vanes had lodged between the frame and a live terminal, where it became wedged so firmly as to cause breakdown of insulation, resulting in serious damage to the stator winding.

It does certainly seem hard to understand the reason why so many otherwise excellent patterns of A.C. motors should be marred and their future working jeopardised by incorporating in the design the now all-too-conventional angular paddles passing for ventilating fans. Invariably attached in a detestably casual manner to some more-or-less convenient point or other of the rotor or its shaft, the determining factor apparently seems to be how least the fitment will interfere with the more important features of the machine design.

One might continue indefinitely describing the many different, and withal indifferent, fans used by motor makers of repute and others not quite so well known. Many cases could be cited of failures arising directly from bad design, not a few of which had broken down repeatedly, from the same cause on each occasion. An effort would appear to have been made by one or two manufacturers to copy the multi-vane runner of a certain well-known type of cased-fan. Usually, such chance copying results in failure to achieve satisfactory results, the reason being not far to seek; and obviously there is another aspect of such practices which does not seem very commendable, to say the least of it.

In passing, a point which rarely receives serious attention, especially by the user, is the amount of power required to propel the average integrally-fitted fan. The results of accurate tests almost invariably prove interesting, and sometimes the figures obtained are surprising, sufficiently so, indeed, to warrant the removal of the fan.

The satisfactory ventilation of electrical machinery by means of fan draught is a big subject, and perhaps hardly properly within the scope of these notes; by courtesy of the editors it may well, however, form the subject-matter for a future article.

# THE ELECTRICITY SUPPLY BILL.

(*Continued from Vol.* 84, *page* 751.)

### The Political Aspect.

Now that the Bill is under actual debate, its political aspect is coming to the fore. As a matter of fact, the Bill might be viewed as compounded of two almost independent elements—one the machinery by which the actual work of unification of supply will be carried out, the other a superimposed administration which shall give it that particular political savour which will make it palatable to the nationalising section. As the Bill stands, it is frankly a nationalising scheme. Whether the Government in giving it this particular garb was merely following a policy of tactics, remains to be seen. Conceivably the Government may have decided to go the whole hog for a start, leaving the whittling down to be done during the progress of the Bill, and thus relieving the Government itself of any charge of not having gone far enough. Without going into questions of abstract economics, there is no doubt that we have reached a position where State control will come, whether any particular party likes it or not. The question is how to adjust the political part so as to give as free a hand as possible to the actual working of the scheme. The practical course would appear to be to make every concession in this direction which would not seriously hinder the working of the undertakings. After all, unification of supply and generation in bulk at a super-station is technical work carried out by a technical staff, and given the same engineers and commercial managers, they would run the station just as efficiently under one administration as another, provided, of course, that there was proper incentive to doing so. This should be taken as the starting point, and the administration adjusted accordingly. The present opposition to the District Electricity Boards is mainly grounded on the claim that as a directly managing body, they are too heterogeneously and clumsily constructed to afford any likelihood of success in actual working. The problem to be solved is how to adjust the political machinery so as to fulfil the popular demands, and leave the actual management as free as in an ordinary business concern.

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Issuing a memorandum closely paralleling that of the Provincial Electric Supply Committee, which was abstracted in our last issue, the directors of the City of London Electric Lighting Co., Ltd., state that they welcome the main principle of the Bill, which is to establish a new body called the Electricity Commissioners for the purpose of promoting, regulating, and supervising the supply of electricity throughout the country. Provided that the Commisssoners selected are men of wide business experience and include some who have practical knowledge of electrical supply, this should greatly simplify and facilitate the development of electric supply generally. But, in the opinion of the directors, the Bill, as drafted, is cumbrous and unworkable, and likely to paralyse rather than stimulate the development of electric supply. Also, the provisions contained in the Bill for the purchase of existing generating stations and transmission lines are most unacceptable, ignoring as they do the Parliamentary bargain contained in the Electric Lighting Acts of 1888 and 1908, on the faith of which the money at present invested in electricity supply has been subscribed.

Shareholders are advised to inform their members of Parliament that, while they regard the appointment of electricity Commissioners as a distinct advance towards the co-ordination of electric supply, they consider it most important that such Commissioners be left free to make whatever arrangements they may deem advisable for improving and developing electricity supply in different parts of the country; are of opinion that many of the provisions contained in the Bill, including the formation of District Boards, are unlikely to effect the purpose aimed at; and protest in the strongest manner possible against the breach of the Parliamentary bargain under which their capital has been invested.

At a meeting of the London Labour Party Executive the provisions of the Bill were regarded as very unsatisfatory; the executive demands that electricity supply shall be entirely owned and controlled by the public, and is pressing this view on the Parliamentary Labour Party.

On Thursday, last week, the money resolution on the Electricity Supply Bill was discussed in Committee of the House of Commons. The resolution authorised the Treasury to advance a sum not exceeding £20,000,000 in connection with the construction of interim works. Colonel Gretton moved an amendment to limit the amount to five millions, and Mr. G. Balfour proposed to reduce it further to one million. Mr. Joynson-Hicks asked for more detailed information as to the purpose of the expenditure, but Sir A. Williamson said that the electrical undertakings contemplated would be of great magnitude, and would be under construction for some years. The precise amount of money required could not possibly be stated. He believed that a large scheme was under consideration, or had been commenced, in the North Midlands, with the sanction of the Ministry of Munitions. The evidence given before the Committee of which he was chairman was in favour of financial assistance from the State until the national system was in working order. Mr. Neal supported the resolution, and Sir Hamar Greenwood, for the Home Office, said there was every reason to believe that the undertakings would be reproductive. The plans could not be restricted to one year, and the proposed reduction would kill the Bill. The amendment was rejected by 136 to 26. Mr. Joynson-Hicks then moved the reduction of the amount of stock on which the Treasury might guarantee the interest from 25 to five millions. Sir Fred. Banbury referred to the financial "mess" that the Government had made of its commercial undertakings hitherto. Sir H. Greenwood said that the Treasury guarantee was only required to enable loans to be raised at a low rate of interest, and Sir A. Williamson said the main purpose of the amount was to pay for existing power stations and lines when they were taken over. There would necessarily be a loss at first, on account of the purchase of obsolete plant, and the insufficiency of the demand to load up the new plant in the early years. The amendment was rejected by 125 to 32, and the motion was agreed to.

A special meeting of the Dublin Corporation passed a resolution expressing the belief that the Electricity (Supply) Bill would not benefit Ireland, and urging that, as the Committee had not investigated Irish conditions, which differ very materially from British conditions, the clauses applying the Bill to Ireland be struck out.

According to the *Times*, Mr. J. B. Braithwaite, chairman of the County of London Electric Supply Co., has resigned his position, and Sir Ernest Hiley has been elected to succeed him; this change is the result of recent negotiations which have resulted in an influential and important group forming connections with the company and its associated concerns. For some time past the company has been making preparations for taking a leading part in any movement that may develop towards improving the electricity supply of the metropolis, and the change in the chairmanship is regarded as indicating that the policy of expansion will now be carried out.

(*To be continued.*)

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**Belfast.**—L.G.B. Inquiry.—The L.G.B. held an inquiry last week into the application of the Corporation to borrow £320,000 for electrical development, the proposed loan being a supplemental one to the loan of £310,750 already sanctioned. For the Corporation it was said that the loan was necessary as the demands of the shipyards, mills and distilleries, for electricity had exceeded anticipation. The city electrical engineer estimated the simultaneous demand in the winter months of 1922 at 20,000 kw. The capacity of the present plant was 17,850 kw., and totally inadequate. Mr. J. H. Rider, consultant to the Corporation, said that the sooner the Corporation extended the building the more profit it would make. The proposed expenditure was justified, and as compared with what schemes were costing in England and Wales, the amounts were small. Even if the shipyard supplies were shut down altogether, the scheme would be profitable to the city. The Harbour Power Station would be the best investment the city had gone in for for many years.

# THE OSCILLATORY VALVE RELAY: A THERMIONIC TRIGGER DEVICE.

By Captain L. B. TURNER, M.A.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The function of a relay is usually that of an automatic switch, whereby the arrival of a relatively feeble signal is made to close or open the circuit of a local battery competent to perform tasks for which the power of the incoming signal is insufficient. There is a threshold strength of signal, below which no local effect is produced, and above which an effect is produced whose magnitude is independent of the strength of the controlling signal.

Amplifiers, unlike relays, have not until recently had a widespread use. Perhaps the Heurtley hot wire and the Brown microphonic contact instruments are the best known. But with the introduction a few years before the war of the three-electrode thermionic tube (De Forest, Lieben-Reisz), and especially with the subsequent introduction of tubes depending on pure electron discharge (Langmuir) and various ingenious methods of using them (mainly evolved by the French), electric amplifiers or "triodes" have suddenly assumed immense importance in wireless telegraphy and are destined in the near future to find the most widespread application.

Fig. 1 shows a triode of a pattern produced by the French early in the war. Here F is the "filament," a tungsten wire brightly incandescent; G is the "grid," an open helix of nickel wire concentric with the filament; and A is the "anode," an outer concentric cylinder of nickel. These are supported in a glass bulb exhausted to the best obtainable vacuum. Triodes of this pattern were designed to be fairly

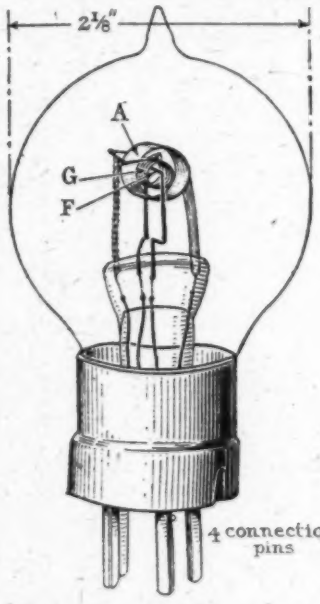


Fig. 1.—A Common Pattern of Triode.

well suited to a great variety of uses; and the consumption of them by the French and British during the war must have run into a good many hundreds of thousands.

If the anode is maintained at a fixed potential $v$ above the negative end of the filament (as by short-circuiting the resistance R in fig. 2), and the potential $v_g$ of the grid is varied, the anode current $i_a$ is found to vary as shown by the curves in fig. 2, each of which refers to a different constant value of $v_a$. Over the steep straight parts of the curves we have large changes of anode current in a high-voltage circuit produced by small changes of potential of the grid. The relation is a linear one; increment of anode current equals a constant $g$ times the increment of grid potential producing it. Inspection of the curves shows further that an increment of anode potential also produces an approximately proportional increment of anode current, $a$ times the increment of anode potential. Now, in the circuits of fig. 2 a rise of anode current produces a fall of anode potential equal to the ohmic drop in the resistance R. As R is increased so as to become very large compared with the anode resistance $1/a$, the amplification ratio approximates to $g/a$. In the pattern of triode we are considering $g = 0.3$ milliampere per volt, and $a = 0.04$ milliampere per volt approximately, so that amplifications up to 8 may be obtained.

Such a device has sometimes been designated a thermionic relay, but this is an undesirable use of the term relay, for there is a very clear distinction between its performance and that of a relay as already described. Here there is no threshold effect, the smallest incoming signal producing some change in the local circuit; and the local circuit effect is a magnified copy, more or less true to scale, of the incoming signal. The distinction between relay and amplifier is a useful one, and should not be allowed to disappear.

Various methods of grouping several triodes, each functioning more or less in the manner described above, have been evolved, and amplifiers suitable for frequencies ranging from units to millions of periods per second have been constructed. They stand out from the earlier amplifiers, in which the velocities of molar masses instead of electrons must be controlled by the signal, in the smallness of the input powers which can usefully be dealt with.

The oscillatory valve relay is a relay, not an amplifier; but it depends on a triode as the link between the "in" and the "out" circuits, and consequently shares with modern amplifiers something of their extraordinary sensitivity, robustness

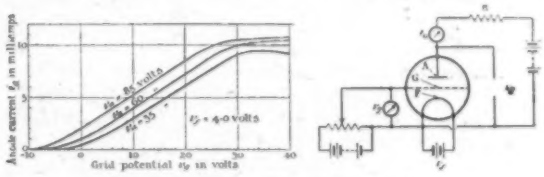


Fig. 2.—Triode Characteristics.

and flexibility as to frequency of operative signal current. Under suitable conditions the system shown in fig. 3 becomes self-oscillatory, drawing the necessary energy from the battery $B_a$ in the anode circuit. If $g$ is less than a critical value, a small oscillation cannot be self-sustaining; if $g$ exceeds the critical value, any oscillation, however small, will increase in amplitude up to an equilibrium value at which the losses in the triode circuits are equal to the power supplied from the high-tension battery $B_a$.

Fig. 4 is an extension of fig. 3 showing how such an arrangement may be utilised as a self-restoring relay adapted to be operated by signal currents of frequencies of the order of hundreds or thousands of periods per second. The grid

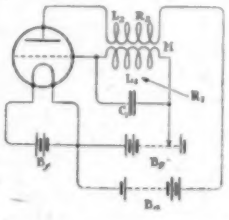

Fig. 3.

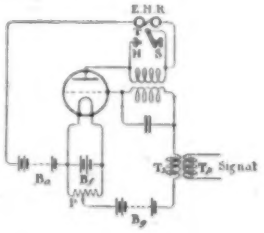


Fig. 4.

Fig. 3.—Self-oscillating Triode System.

Fig. 4.—Circuits of Valve Relay for Low-frequency Signals.

potential is finely adjustable on the potentiometer P; and when it is set a small amount, called the "margin," below the critical value, called the "threshold," any signal applied to the transformer $T_p$ $T_s$ producing in $T_s$ a momentary electromotive force of the right sense and exceeding the margin in amplitude, sets the system into oscillation. The accompanying rise of current in the coils of the electro-mechanical relay E.M.R. (ordinary telegraph relay) pulls over the tongue T, short-circuits the anode reaction coil, and thereby quenches the oscillation, which is thereupon only re-ignited on the arrival of another signal in the transformer primary $T_p$. The opening of the contact between T and S may be used to control any indicating or other relaying apparatus.

In the form of valve relay sketched in fig. 4 we are not interested in the frequency of the oscillation; we are concerned merely to arrange that the incidence of oscillation shall be marked by a conveniently large rise of mean anode current. For several reasons, however, it is convenient to make the frequency high, or at least enormously greater than frequencies of the order of those of the signal currents. In the valve relay described in the next section the frequency is about $4 \times 10^5$ periods per second.

Fig. 5 is traced from a photograph of a valve relay designed for signals of acoustic frequencies, containing its own grid and anode batteries and requiring externally only a 4-volt battery for the filament. It is provided with a small electric lamp as an indicator, together with a change-over switch allowing any external apparatus to be substituted for the

lamp. It was designed to replace the ordinary telephones used to read Morse signals from a wireless receiver, or over the wire of an ordinary buzzer field telegraph set. It may of course be used after an interposed amplifier, but without any amplifier it is sufficiently sensitive to respond to signals only strong enough for comfortable commercial work, such as are said in Army notation to be of strength "R7."

[A demonstration of the smallness of the energy required to trip the relay was provided by connecting an ordinary microphone, with transformer and 2-cell battery, as the source of signals. The microphone was provided with a small trumpet,

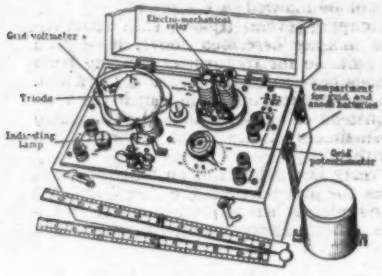


Fig. 5.

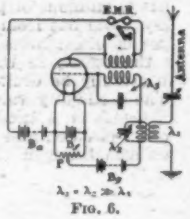


Fig. 6.

Fig. 5.—Valve Relay for Acoustic Frequencies.

Fig. 6.—Circuits of Valve Relay for High-frequency Signals.

and the relay responded to a clap of the hands or a shout in any part of the lecture theatre.] The power of the steady incoming signal sufficing to operate this instrument is of the order of $10^{-8}$ watts. An ordinary Post Office telegraph relay, of the type which is embodied in this instrument and is controlled by the anode current of the oscillating valve, requires an operative power of at least $5 \times 10^{-3}$ watts for reliable working even at low speeds. The war has proved the high-vacuum triode to be an instrument adapted for unskilled use in the field of battle. The only adjustment in this instrument is that of a potentiometer to regulate the potential of the grid to a tenth of a volt or so.

This relay may be said to be of aperiodic or non-tuned type in that the frequency of the signal current bears no relation to the frequency of the oscillation set up. Such a type is well adapted to acoustic frequencies, because it is feasible to build for such frequencies quasi-aperiodic transformers capable of producing on the grid (whose impedance is sensibly infinite at such frequencies) a large rise of potential with an expenditure of only minute power. If the aperiodic iron-cored transformer is replaced by suitable tuned high-frequency circuits whose frequency is, however, still much below that of the oscillation generated in the relay, a relay of like sensitivity, but for high-frequency instead of acoustic-frequency signals, can be constructed. Such a relay for wireless signals is sketched in fig. 6.

But where high-frequency currents such as those of wireless telegraphy are required to operate the relay, particularly if these are undamped or "continuous wave," an immense advantage accrues from tuning the oscillation-generating circuits of the relay to the frequency of the operative signals. Sensitivity is greatly enhanced, and there is added the pos-

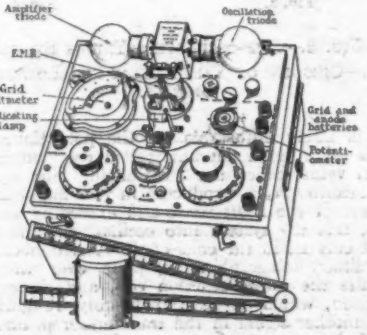


Fig. 7.—A Valve Relay for Wireless Signals.

sibility of an exalted selectivity as between signals of unequal frequencies and between signals of the same frequency but unequal decrement. The $\lambda_2$ circuit of fig. 6 is then conveniently omitted, the $\lambda_1$ and $\lambda_2$ circuits are coupled together, and $\lambda_3$ is made equal to the wave length $\lambda_1$ of the antenna and the incoming signal. To prevent the antenna being set into violent oscillation by the relay (as well as to obtain additional sensitivity), one or more amplifying triodes may be interposed between antenna and relay.

It should be noticed that the high-frequency valve relay, unlike other wireless receivers, embodies neither heterodyne nor rectifier.

A valve relay receiver designed for wave lengths of 1,500-3,000 metres, containing its own grid and anode batteries, and comprising one high-frequency amplifying triode, is shown in fig. 7, which is traced from a photograph.

This valve relay is, by movement of a switch, converted into an ordinary autoheterodyne receiver, and is used as such when tuning up to a continuous-wave signal, the final tuning being to the "silent space," *i.e.*, to zero beat frequency. On then switching over from "phones" to "relay," and adjusting the potentiometer to a potential just below the threshold, we are left with a circuit exactly tuned to the incoming signal and of nearly zero decrement. The discrimination between continuous-wave and spark signals observable with this simple instrument is very striking. Thus a spark station of nearly the same wave-length as a desired C.W. station, and strong enough to jam the latter hopelessly as an autoheterodyne receiver, can be made innocuous for reception on the valve relay.

In the two forms of valve relay already described, the signal current was alternating or intermittent and produced the requisite rise of grid potential by the simple mediation of some form of transformer. For the relaying of slowly changing currents such as those from telegraph cables, the current and not its rate of change must be made to affect the relay. This is easily accomplished, with striking sensitivity, by placing an inductance of suitably large time-constant in the circuit, accumulating energy therein as long as the conditions permit, and then causing the current to change rapidly, as by breaking the circuit of the inductance, thus producing momentarily a large potential difference across the inductance. This momentary potential difference is applied directly, or through a step-up transformer, to the grid of the valve relay. Thus in fig. 8 the incoming current from a cable charges condenser C. The switch tongue P of the automatic switch P Q R alternately dwells on contacts Q and R. During the Q contact a current from the cable and condenser C grows in $T_p$, storing energy in the transformer. When P leaves Q this current rapidly falls to nothing, producing a change of grid potential. This trips the relay, which is subsequently quenched by contact between P and R or by other means.

The sensitiveness to positive and negative currents may be made very unequal, and two such relays may be associated for double-current working.

In a trial with a certain transformer $T_p$ $T_s$ (fig. 8), it was found possible to trip the relay reliably by breaking 4 micro-amperes in a primary of about 1 henry. The energy $\frac{1}{2} L i^2$ available for tripping the relay was thus $8 \times 10^{-12}$ watt-seconds. Experiments on tripping a Post Office standard polarised relay in a similar manner show that for this relay

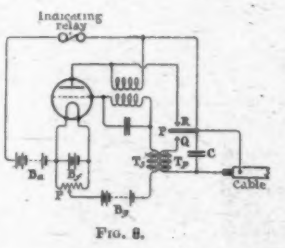


Fig. 8.

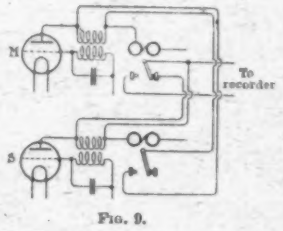


Fig. 9.

Fig. 8.—Circuits of Valve Relay for Quasi-steady Currents.

Fig. 9.—Interquenching Circuits for Double Valve Relays.

a corresponding energy of at least $5 \times 10^{-4}$ watt-seconds (1 milliampere in over 100 henries) is necessary, *i.e.*, over a million times as much as for the valve relay.

The valve relay in this form must, it is thought, be adaptable to submarine cable working; but this is not an easy problem and only preliminary trials have so far been made.

When the relay has been tripped and the oscillation started, it has to be reset by quenching the oscillation and allowing the currents in the anode and grid circuits to die down to their non-oscillatory values (small and zero respectively). This is, of course, an asymptotic process never fully completed; and if the rate of fall of current is still appreciable when the quenching contact is reopened, there is an extra potential on anode or grid or both tending to reignite the oscillation. The longer the duration of quenching contact, the smaller the reigniting potentials will be; but, whatever they are, they must be provided for by a margin sufficiently wide to make them inadequate to trip the relay afresh.

For high-speed work, the acoustic valve relay of fig. 5 is, as it stands, unsuitable. The tongue of the mechanical relay must quench at least several times during a Morse dot, and in this instrument its speed is insufficient for signalling at more than about 20 words per minute. The slowness is due to the fact that during oscillation a considerable mean grid current (about 0.2 milliampere) is built up in the secondary of the signal transformer which is of large inductance (some 50 henries). By using a triode with coarser grid and higher anode potential, this grid current can, however, be wholly suppressed. In the high-frequency form of relay grid current is harmless, since there is no large inductance in the grid circuit. The anode current in the magnets of the mechanical relay is then the limiting factor. The wireless valve relay of fig. 7 is satisfactory up to 40 or 50 words per

minute. For higher speeds it is preferable to provide for weaker oscillation and use an externally operated quenching switch, the mechanical relay being retained as an indicator only. The mechanical relay has then to move over only once per Morse dot, instead of several times per dot.

In the endeavour to reach really high speeds such as several hundred words per minute, the limit must ultimately be fixed by inability to quench fast enough. At 100 words per minute, with 5 quenches per Morse dot, the duration of quenching contact must be less than 1/400 second. An ingenious arrangement for double-current (or two-signal wireless) working, which avoids the necessity of quenching more than once per Morse dot, has been devised by Major Fuller, R.E., and Lieut. Lemon, R.E., of the Signals Experimental Establishment. The principle is shown in fig. 9; M and S are the two valve relays, adapted to be tripped by the marking and spacing signals respectively. The tongues are shown in their positions of rest, the triodes not oscillating. At the beginning of a marking signal, the upper tongue moves to the left and stays there. At the beginning of the subsequent spacing signal, the lower tongue flicks over to the left, and quenches M, whose tongue thereupon falls back to the right; this quenches S, thus restoring its tongue to the right; and all is still until another marking signal arrives.

It is not claimed that the new relay is a receiver of unique sensitivity. But it is believed that no other relay capable of being manipulated by operators not highly skilled, and able to withstand ordinary conditions such as draught and vibration, can approach its performance.

A wireless call device for the small islands and lighthouses lying a few miles off our coasts can be provided with the aid of the relay here described.

The valve relay responds when the signal reaches, if only for a brief moment, a certain strength, adjustable by the turning of a potentiometer handle, and expressible with precision as the difference between two voltmeter readings of the gird potential. It constitutes, therefore, a simple and convenient instrument for measuring peak values of potential or current, of any frequency and wave-form; and, in one such particular application, may prove an aid to precise wireless experimentation as a ready means of measuring signal strength. The instruments have been produced at the Signals Experimental Establishment, Woolwich.

### Discussion.

Mr. A. A. Campbell-Swinton drew attention to the wonders which had been accomplished during the war; the triode was one of the most wonderful discoveries in physics, and derived its origin from a purely scientific research, with no utilitarian purpose. Sensitivity was not the most remarkable feature of the relay—the Heurtley and Orling relays were more sensitive; but any number of amplifier valves could be put in cascade, each magnifying the effect. At the National Physical Laboratory he was told that there was no difficulty in using six tubes in cascade, each magnifying 18 times, making a total amplification of 34 million times. Ordinary relays produced distortion, which was magnified by putting them in series; with the valve there was no distortion save that due to the transformers, &c. Signals from a 100-kw. station 200 miles away could be received with a coil of wire one yard in diameter, the actual power received being of the order one twenty-millionth of a watt, and with this recording instruments could be operated.

Mr. J. E. Taylor said that it would have been more appropriate to compare the valve relay, not with a P.O. relay, but with a coherer. Used in the right way, with not more than 0.5 volt across it, the coherer was much more reliable than many supposed, and might still be of use for some purposes. He inquired whether the valve relay was more immune from atmospherics than the coherer.

Dr. E. W. Marchant said that during the last few years he had had to emphasise the importance of technical research; the invention of the valve was certainly a wonderful scientific achievement, but it had required an immense amount of technical research by very able men to develop it to its present state of efficiency. He gave a simple account of the physical phenomena of thermionic currents, and asked whether Capt. Turner had ever tried using a leaky condenser conected between the grid and the negative terminal, with which the grid potential could be controlled quite easily.

Professor Fortescue said that in the early days of reaction receivers the tendency to oscillate was troublesome, but Capt. Turner had shown how to utilise that tendency. He referred to the employment of the device as a detector for acoustic reception, and pointed out that the use of the relay involved the loss of the distinctiveness attached to the note of the sending station. The relay would have a useful application as a calling-up device. In the past the designer of triodes had been concerned to control the slope of the characteristic; he would now have to control its curvature also.

Mr. Binyon agreed that the instrument acted like a coherer, but much better; Capt. Turner also used a decohering device, but it was electrical not mechanical. He asked whether it was possible to listen-in whilst the relay was working; that was a matter of vital importance for commercial work, in order that the operator might be able to keep the adjustments perfect. He agreed with Professor Fortescue as to the advantage of oral reception, the human ear having an extraordinary selective power. The rate of quenching would be important, especially at high working speeds. The mechanical quenching mentioned by the author seemed to be better than the electrical method.

Mr. Wells said that no country in the world was so well provided with underground cable communication as this. The first cables were designed for telegraph work only; later, telephony was also provided for. The problem of the future was to use all the wires indiscriminately for both purposes. He asked whether the relay could work at 200 words a minute.

Mr. Hart said the subject was of great interest to wire telephone engineers. The perfection of the triode had made possible the use of practical telephone repeaters, and had already revolutionised practice in long-distance communication. They were now specifying for telephone trunk lines with one-tenth the weight of copper formerly used. Whereas the limit used to be the speaking, it was now the question of signalling for calling and clearing, and they had had to insert signal repeaters at intervals, which was very undesirable. They were trying to use the triodes to relay the signalling currents. These relays would have to respond to signalling currents of the same order of magnitude as the speaking currents, but must not respond to currents of speech frequency.

Mr. Nash referred to the use of the device in the Navy to actuate calling signals for wireless telephony. The French valves at first used were not satisfactory, owing to the effect of mechanical vibration on the grids, which were not supported rigidly enough.

Major Prince pointed out that Capt. Turner had succeeded where many had just failed; a special feature of his device was the possibility of absolute tuning.

Mr. B. S. Gossling said the author had presented the valve maker with new problems, and they were designing for the curvature of the characteristic, which was thoroughly understood, being dependent upon natural constants.

Mr. A. C. Brown asked whether Captain Turner had tried using current from public mains for the filament, which would offer the advantage of dispensing with accumulators.

Capt. J. Coxon, R.E., said that the triode relay was only one of the many developments that had taken place in the Signal Service; the greatest credit was due to the officers of that service, and to the wireless telegraph amateurs who had enlisted and had done very valuable work. He asked what was the relative value of the relay compared with the use of valves without relays.

Briefly replying, Capt. Turner said that the comparison between the triode relay and the coherer was very apposite; it was to all intents and purposes a coherer, but was more manageable. The coherer, however, was not operated by potential but required an appreciable amount of power; the grid of the relay could be regarded as taking no power. Listening-in was certainly necessary, and there was no difficulty in using a separate receiver, but the valve relay could not be used as an auditive receiver. He agreed that the loss of the distinctive note of the sending station was regrettable. Electrical quenching was much superior to mechanical; the interquenching system relieved the relay of chattering, and only had to quench once per dot instead of, say, five times. The possibility of "dead-on" tuning was very important; it offered a great advantage in C.W. signalling as compared with the spark system. By setting the grid potential very near the threshold the decrement was reduced almost to zero, and the oscillating system became exceedingly sensitive for selection.

## THE INSTITUTION OF ELECTRICAL ENGINEERS.

### Conversazione and Dinner.

After an interval of five years, the Institution of Electrical Engineers last week resumed the annual social functions which in pre-war days were so highly appreciated by the members and their friends. The conversazione was held at the Natural History Museum, South Kensington, on Wednesday, June 25th, the guests being received by Mr. C. H. Wordingham, C.B.E., President I.E.E., and Mrs. Wordingham, supported by the Council. The special purpose of the conversazione was "To meet the members of the Institution who have served in H.M. Forces during the War," many of whom were present in uniform. There was a very large attendance, numbering some 1,300 persons. Over 2,000 of the members have served in the war, of whom 160 gave their lives in the cause of liberty and civilisation.

With his customary independence of precedent, the president introduced a happy innovation in the shape of a speech of welcome to the guests, which is reproduced below:—

Ladies and gentlemen,—On this joyful occasion our dominant feeling must be one of thankfulness; primarily to God for having brought this nation through this crisis in its history in triumph shared with its noble Allies, and for the peace which is the immediate consequence of that triumph. Thankfulness also for the bringing back in safety of those who are with us to-night, and whom we are assembled to welcome and to honour. Secondarily are our hearts thankful to those whom He has used as His instruments in the persons of those who have fought and many of whom have died to secure that triumph and peace.

It is no hypocrisy to say that we have not won this war in our own strength. Although we were fully warned we were utterly unprepared. We had but a handful, as armies now go, of trained men, a Navy which we are assured on the highest authority was deficient in certain vital respects, we had practically no hospital ships or ambulance trains, no adequate supply of suitable armament, and we were matched against a nation which had spent forty years in steady preparation, which had sucked the brains of every other nation for ideas and inventions, which stopped at no degradation in the practice of war, using the foulest methods of the vitriol thrower and murderer, and yet we won. We may say it was due to this man or to that, to the sailor or the engineer, to our money, or to our cleverness, but if we are honest we shall say that we owe it to God's goodness and mercy.

It is true that many of those who stayed at home have been just as indispensable as those who have fought, and they have done their utmost to contribute to the result of the nation's effort, but after all nothing can come up to the services of those in the field. They have worked as hard as any for longer hours than most, and over and above all they have faced the foe at close quarters. It was no ordinary foe, but a foe without a spark of honour, chivalry, or human feeling, a foe full of bluster when victorious with overwhelming odds on his side and a craven and snivelling coward when beaten. A foe with whom though he sign a treaty of peace we must ever be alert to watch lest at the last he sting us like an adder.

We as engineers are specially proud of our men because while a large proportion entered the ranks, the greater number subsequently earned commissions. We are proud of their merit, but especially proud because the facts show that an engineer's training fits him for administrative work and the command of men.

The Council considered many ways of welcoming back those whom we desired to honour, but we felt that nothing could be better than this conversazione, because it gives all members an opportunity of talking to one another personally. It is five years since the last conversazione; few of us have escaped bitter loss in that time, and the thoughts of many of us will be with those no longer with us. We shall not diminish the heartiness of our welcome to those among us to-night because we do not forget those who have not returned. Let those who are bereaved join heartily with the others in welcoming home the men who have been spared to those who love them. To one and all, whether they come from land or sea or air, I extend the warmest, heartiest, and sincerest welcome from every member of this Institution.

Amongst those present were: Sir Charles Bright, F.R.S.E., Lieut. Sir A. Whitten Brown, K.B.E., Sir Thomas O. Callender, J.P., Colonel Sir T. H. Holdich, Sir H. E. Haward, K.T., Rear-Admiral Giuseppe de Lorenzo, Sir Henry Penson, Sir Francis T. Piggott, Sir R. Henry Rew, The Rt. Hon. Lord Shandon and Lady Shandon, Major-General Sir A. W. Stuart, C.B., and Sir Harry Wilson.

There were also present: Messrs. L. B. Atkinson, F. W. Crawter, J. Devonshire, J. S. Highfield, J. F. Nielson, C. C. Paterson, O.B.E., W. R. Rawlings, C. P. Sparks, Colonel H. C. Sparks, C.M.G., D.S.O., M.C., and Mr. W. B. Woodhouse, Members of Council; and Mr. P. F. Rowell, Secretary.

The entertainment was exceptionally elaborate, the Western Gardens being thrown open on this occasion; the bands of the Royal Regiment of Artillery (conducted by Lieut. E. C. Stretton, M.V.O.), and H.M. Coldstream Guards (conducted by Major J. Mackenzie-Rogan, M.V.O., Mus. Doc.) performed programmes of music, and concert parties gave excellent entertainments in the Central Hall and the gardens. Many members attended from the provinces, including a number who were present at the I.M.E.A. Convention. The function was thoroughly enjoyed.

The annual dinner was held at the Connaught Rooms, on Thursday, June 26th; Mr. C. H. Wordingham presided, and there were some 320 guests, including Mr. C. O. Mailloux, Past-President Am.I.E.E.; Sir G. H. Makins, G.C.M.G.; Rear-Admiral Giuseppe de Lorenzo, K.C.M.G.; Lieut.-Gen. Sir W. T. Furse, K.C.B., D.S.O.; Rear-Admiral F. L. Field, C.B.; Colonel Sir A. M. Ogilvie, K.B.E.; Sir Evan Jones, Bart.; Col. Sir T. Holdich, K.C.M.G.; Sir Robert Hadfield, Bart., F.R.S.; Sir H. Rolleston, K.C.B.; Sir Frank Heath, K.C.B.; Sir H. P. Burt, K.C.I.E.; Brig.-Gen. C. P. Martel, C.B.; Prof. C. H. Lees, F.R.S.; Dr. C. R. C. Lyster; Dr. E. Hopkinson, M.P.; Col. C. O. Armstrong; Dr. G. B. Batten; Mr. Stanley Machin; Mr. Roger T. Smith; Mr. W. Noble, and many members of the Council of the Institution.

After the loyal toasts, in the absence of Sir H. Greenwood, Mr. C. O. Mailloux proposed "The Institution of Electrical Engineers," to which, he said, he had looked up with admiration from his early youth; himself one of the founders of the American Institute of Electrical Engineers, he highly prized his membership of the British Institution, which had brought him into contact with some of the greatest men in science and engineering. He recalled the great tour of the Institution throughout Great Britain in 1901—a tour which, on account of its surpassing interest and faultless organisation, was a model of its kind. In the United States during the war a profound respect for "the great unboasting British" had grown up; Americans had not been so cordially disposed towards England during the Boer War, as she then was not so friendly towards France as towards Germany, but while England might make mistakes, she always recovered from them, and Americans admired the British for the way in which they had "made good." They were a great people, who triumphed over all obstacles without talking about themselves, and he was glad to be privileged to express the feelings of gratitude of the Americans to them for the work they had done in setting the world right. The Institution had played a great part in the war; many of its members had laid down their lives in order that the world might live, and if the war had done nothing else, it had taught the Americans to respect and admire the British nation, and to claim brotherhood with it. They had eagerly looked forward to being allowed to come into the war side by side with England. The American Institute and the British Institution had always worked well in parallel, and the war had brought them into closer synchronism, without any cross currents—now they would work together better than ever.

In reply, Mr. C. H. Wordingham said it was peculiarly appropriate that the toast should have been proposed by an American; the two peoples had fought shoulder to shoulder in the war, and were co-operating more closely than ever before in electrical work. The British Engineering Standards Association was helping in the evolution of the American Standards Association, and he hoped that in all technical matters they would co-operate and exchange information with the Americans, and foster even more cordial relations than in the past. The Institution represented the whole of the British electrical profession and industry; the membership was close upon 8,000, and they had been working in close relationship with other associations, with the happiest results. A committee had been dealing with the vital question of the Electricity Supply Bill, and the Council would shortly send forward its considered opinion as representing all branches of industry. The Institution was preparing to help the Electricity Commissioners by appointing a representative committee to consider the whole question of overhead mains and electrical transmission; a research committee had been studying underground cables, and hoped to lay before the Electricity Commissioners a great deal of valuable information; a Committee on Patents, with Mr. Mordey as chairman, had produced a most valuable report, and had prepared a workable scheme for an Empire patent. It was understood that the Institution building would be restored to them very shortly, and they hoped to return to it in September. The electrical industry was unique in its variety and scope; no other industry could be compared with it. It was impossible to apply to such an industry any cut-and-dried scheme, and this was particularly true in respect of research. The hard and fast constitution of the Research Department was not applicable to the electrical industry, which well understood the value of research, and he hoped the authorities would give a sympathetic ear to its special needs, and would allow the electrical industry to conduct its researches and receive assistance on the lines put forward by its accredited representatives. Another point of the first importance was that the industry was in a state of rapid flux, especially in the supply branch; conditions were constantly changing, and every encouragement should be given to individual enterprise and invention. Every Government control should be as light and elastic as possible, and the wishes of the industry should be taken into consideration in every case by consulting the Institution. He proposed that the following message should be sent to the kindred institutions in the United States, France, Italy, and Japan: "Fraternal greetings to their brother electrical engineers, allies in war and peace, from members of the British Institution of Electrical Engineers assembled at the first festival since the outbreak of war in 1914."

Mr. H. B. Woodhouse, Past-President, proposed, "Our Guests," and remarked upon the extraordinary ramifications of the electrical industry, which was involved in every branch of science and industry, peace and war. He referred to the distinguished guests present from Italy and the United States, as well as our own representatives from the military services, and the recent shortening of the Atlantic crossing by British and American airmen, of whom the former was a member of the Institution (Sir A. Whitten Brown).

In reply, Rear-Admiral F. L. Field, C.B., Director of Torpedoes and Mining, drew a contrast between the early days of his service when electricity had no place on board ship, and the present time, when a modern warship was a mass of electrical apparatus. The difficulties of the naval electrical problems were enormous, and the whole equipment had to be built up in pre-war days without knowing what the effect of an action at sea would be; those who had been associated with the work under their distinguished president in solving these problems must have had the greatest satisfaction in seeing the electrical equipment pass through the test of battle satisfactorily. On the outbreak of war many electrical engineers offered their services, and innumerable schemes were tried; they had rendered enormous assistance to the Navy at sea and ashore. The Navy ought to have had *before* the war members of the electrical profession working in its experimental establishments on mining, wireless telegraphy, and other branches of the service; the naval authorities had learnt the lesson, and in future they would have such assistance in time of peace.

Lieut.-Gen. Sir W. T. Furse, K.C.B., D.S.O., Master-General of the Ordnance, replying to the toast, said that before the war they had suffered from the evil of loving to dwell in watertight compartments; the war had taught the

whole country what the profession of arms really meant. They had benefited enormously by the skill, energy, and enterprise of the electrical engineers, and they wanted that help to be continued. A very important committee was sitting with regard to the future of the Royal Engineers; a report would soon be issued, and would show that the liaison which the war had fostered between the Royal Engineers and civil engineers must be preserved. In spite of the League of Nations, they *must* be prepared for the next war, and the best preparation would be that electrical engineers should sit on the military research committees, and that the civil research committees should not forget the applications of science to warfare.

The company afterwards adjourned to the reception room, and passed a pleasant hour in renewing old friendships and cementing new ones. A programme of music was provided by the British Imperial Orchestra, and the entertainment was in every way successful.

## CORRESPONDENCE.

*Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Tariffs on Imported Manufactured Goods.

Mr. Belling's insistence on the necessity for protection for the electrical engineering industry led me to refer again to a book on Protection published in 1901 by an eminent pioneer electrical manufacturer. He wrote:—"I am a manufacturer. My case is that of every producer in this country. My capital and business are imperilled; the living of the thousands of workmen I now employ is at stake, and if the safeguards for which I plead are denied me, I shall be compelled to cease to be a producer." . . . . "I venture to make this prophecy, that by 1912 there will be no history of English Free Trade to record. There will be either *no Trade*, or there will be *Protection*."

Need I inform Mr. Belling that the author of this statement, which is as clean-cut and emphatic as his own, was the head of a very large and successful electrical manufacturing firm, whose employés and capital have not only survived the perils of Free Trade, but have even increased many-fold since the prophecy was made. Of course this does not absolutely prove that Mr. Belling is wrong in his day, but it gives substantial grounds for hope that his fires will bring comfort to himself and others for much longer than he fears.

Great importance is attached to the advantage which an American manufacturer has in the large reserved home market, but it is quite unfair to imply that every one of them is able to lay himself out, like Henry Ford, to cater for the majority of the 100 millions of people. In every line of business there must be scores or hundreds of firms competing for and dividing the trade so that the advantage of quantity manufacture will be in proportion to the output of individual firms, and not in proportion to the size of the country. I should like to ask Mr. Belling if he is prepared to state from actual knowledge that no manufacturer of electrical heating appliances, on his scale of output, can exist in the United States. If small firms can exist over there, there is no reason for losing heart over here.

The fact that America, Germany, and Japan have rapidly forged ahead behind tariff walls is given as the most convincing general proof of the advantages of Protection—a kind of summation of the petty pros and cons which must carry conviction to the meanest intelligence. I grant that the fact is undeniable, but submit that the inference is wrong unless it can also be shown that all tariff-walled countries with manufacturing possibilities, such as France and Austria, have developed likewise. As this is manifestly not the case, there must be other factors of very great, or even greater, importance, and I suggest that one of them is the wider and deeper cultivation of scientific research and method. My suggestion is even supported by the highly-technical nature of most of the articles mentioned as typical of the high-grade products which we obtain from Germany and America.

Mr. Belling is inaccurate in many of his statements, of which I have only space for one illustration. He states that articles imported from tariff-walled countries are *invariably* (the italics are mine) of the highly-skilled, high-wage paying class. Surely one of the planks of the Protectionist platform is the discouragement of the import of the products of sweated labour.

The most interesting and striking of Mr. Belling's statements is as to the effect of tariffs on the type of the world's work which ultimately falls to a country, and he suggests that we are on the way towards becoming a nation of unskilled manual workers. This is a very complex problem in economics, but Free Traders have good reason for general optimism in the utter failure of the forecasts of the prophets of decadence of 15 years ago, after a lapse of time which they themselves considered more than sufficient for an endurance test. We are still a manufacturing nation, but, unhappily, our future is threatened by graver perils than those of either Protection or Free Trade.

F. Greenhalgh.

Bolton, *June 28th*, 1919.

## LEGAL.

### Workmen's Compensation Case.

At Preston County Court, last week, Messrs. Dick, Kerr & Co. asked for the termination or diminution of the weekly payment of compensation in respect of an accident on August 20th, 1918, which led to the amputation of a portion of the second finger on the right hand of Sarah Ellen Miller through a shell falling on it. It was argued that respondent was now able to work, either at her old occupation or some other.

Judge Sturges estimated respondent's earning capacity at £1 a week, and reduced the weekly payment to 15s.

### Breach of Electricity Regulations.

At the Manchester Police Court, on June 25th, the Hill Crest Oil Co., Clayton, were summoned for a contravention of the electricity Regulations.

Mr. W. H. Seal, for the prosecution, said the case was founded on the Regulations as to adequate safeguards against persons sustaining electric shocks. A boy named Robertson was using a portable electric lamp whilst flue cleaning, when he touched the live wire of the lamp, and was practically electrocuted.

Mr. Branthwaite admitted that a technical offence had been committed. The lamp was installed for the purpose of inspecting the oil stills of the works. It was never contemplated by defendants that it would be used for any other purpose.

A fine of £10 was imposed.

### Marconi's Wireless Telegraph Co. *v.* The Crown.

Mr. Justice A. T. Lawrence on Monday, June 30th, sat again at the Royal Courts of Justice for the assessment of damages due to the Marconi Wireless Telegraph Co. in respect of a breach of contract, by which the Marconi Co. were to construct an Empire chain of wireless stations.

The claim by the Marconi Co. is £7,181,774, based on a royalty of 10 per cent. on the gross receipts from the stations to which, they claimed, they were entitled under the contract for 28 years.

Mr. Godfrey Isaacs, managing director of the Marconi Co., was further cross-examined by the Solicitor-General. The Solicitor-General put to the witness some tables of cable traffic from 1904 to 1913, and suggested that in no case did they show a 10 per cent. increase.

Mr. Isaacs disagreed. He said the 1910 return showed an increase of 10·2 per cent., the 1912 an increase of 11·9 per cent., and the 1913 an increase of 13·9 per cent. To go back to 1904 was, he thought, going back too far, as conditions had changed so much since then. Mr. Isaacs had previously instanced the Marconi wireless service with Spain to show how wireless traffic increased.

The Solicitor-General asked whether this increase was not due to the strike of Spanish telegraphists?

Mr. Isaacs replied in the negative. He said the Spanish service was only begun in March. It showed an increase week by week, and the last week in April showed a traffic of 40,000 words, which was equivalent to an annual traffic of 2,000,000. The traffic fell off during the strike.

The Solicitor-General put questions to Mr. Isaacs about the stations which were provided for in the contract.

It would, said Witness, have been possible to communicate with Australia from Singapore.

The Solicitor-General: The Australians are not going to use Marconi, are they?—Mr. Isaacs: I don't know on what authority you say that.

They have refused, have they not?—I am quite sure they have not.

The Solicitor-General closely questioned Mr. Isaacs about the company's unexpired patents, and

Sir Edward Carson mentioned that the company had given the Crown every possible information. "They have," he said, "even gone to the length of asking us for a list of our future inventions."

Mr. Isaacs said it was true the Federal Telegraph Co. established a wireless service between San Francisco and Honolulu in 1912. That was a distance of 2,100 miles. He believed it involved the use of the Marconi receiving patents. The American Navy Department had established wireless between Honolulu and the Philippines, a distance of 4,600 miles, and this involved, he believed, the use of some of the Marconi patents. The U.S. Navy authorities also had a station near Washington, where, he thought, the Poulsen system was in operation. He believed it communicated with Darien, in the Panama Isthmus. These stations, being strategic, did not compare with commercial stations. Witness said he had not heard of other stations which counsel suggested the U.S. Navy Department had erected on Guam Island, in Alaska, and other places. He understood that the French Government had erected Poulsen-system stations at the Eiffel Tower and at Nantes.

At a later stage Mr. Isaacs declared that the Poulsen arc system was a thing of the past.

The hearing was adjourned.

**Electric Vehicle Construction in Sweden.**—A new company has lately been organised in Stockholm, with the title of the Svenska Elektrobil Aktiebola, to establish works for the construction of electric motor vehicles.

# BUSINESS NOTES.

**Sale of Government Machine Tools.**—An important sale by auction of engineers' machine tools has been recently conducted by Messrs. Fuller, Horsey at the National Projectile Factory, Lancaster, involving the realisation of machinery to the value of about £150,000. The tools included lathes, drilling machines, shapers, slotters, and planers. This was the first sale held by the Government in which the principle was followed that every second-hand machine before being offered should be put in such a condition that a purchaser could immediately set it to work in profitable production. Buyers came from places as far apart as Greenock and Brighton, Yarmouth, and Plymouth.

**Industrial Relations.**—A meeting of the General Council and members of the National Alliance of Employers and Employed will be held to-day (Friday) at the Caxton Hall, Westminster, when addresses will be given by the Right Hon. Arthur Henderson and other members of the National Industrial Council, and a discussion will take place on the effect upon the work of the Alliance of the establishment of an Advisory Council of Employers and Employed as recommended by the Committee of the National Industrial Council. In the evening Lord and Lady Brassey are entertaining the members of the National Alliance to an evening party at 24, Park Lane, W. The National Alliance has now established 30 Joint Committees of Employers and Employed in various provincial centres.

**Prohibition of Imports of Electrical Machinery, &c.**—The *London Gazette* of June 27th contains notice of a proclamation prohibiting the importion into the U.K. of the following articles except under licence by the Board of Trade :—

Chemical goods of all description.

Electrical goods and apparatus, including electrical plant and machinery of all kinds and insulating materials of all descriptions.

Scientific, mathematical, and optical instruments.

Tungsten powder and ferro tungsten.

**The Lead Market.**—In their report, dated June 28th, Messrs. G. Cawson and Co. say that lead is being offered from Australia for forward shipment down to £22 5s., and this will no doubt continue ; the high price of silver must tend to increase the output of lead. "Germany, too, is offering lead in Holland and Scandinavia far below the parity of London prices, and at the present rate of exchange they are nominally making a large profit ; in fact, if exchange does not improve, they can sell to these countries quite below this market, and thus stop our export trade. If after Peace is signed they are allowed to sell here, we may still see a continued flat market. Consumption is not satisfactory, although electrical works are using a fair quantity of lead ; in other directions the demand continues very poor."

Messrs. James Forster & Co., reporting on the same date, say :—

"Controlled" lead remains at £24, with special terms for large quantities.

Apart from the fact that current prices are certainly below costs to most producers and that consumption is increasing steadily, there seems to us little to go for in buying forward. Stocks are too large to admit of rising values. Mr. Govett, at the yearly meeting of the Zinc Corporation, stated that the stock in Government hands and in Australia alone amounted to 330,000 tons—a truly gigantic quantity, and equal to 1½ year's pre-war consumption here. Without careful nursing, prices are bound to go lower, but the stocks are in strong hands.

**Trade Schemes for Chile.**—Det Norske Aktreselskab, for Elektrokemisk Industri and its associate the Norsk Industri-Hypotekbank, are about to establish a branch in Chile under the style of the Electro-Quimica Limitada, Compania Chileno-Noruega Industrial i Financiera. Its object is to employ hydraulic power for the development of Chilean industries, to exploit new patents, and to give financial support to industrial undertakings generally (factories, mines, railroads, telephones, &c.). The business will be organised in three sections—industrial, financial, and commercial, the last under the title of "Transactor," having a separate existence. The head office will be at Valparaiso, but branch offices will be opened in different parts of the Republic. Chilean capital will be invited to share in any new industries started.

**Associated Action by Driving Chain Makers.**—During the war British driving chain manufacturers were enabled to meet the unprecedented demands of the Allied Governments by acting in co-operation. They have now formed a permanent association for fostering the use of chain gearing and reducing the cost by means of standardisation and the elimination of unnecessary sizes, thus securing increased output and more efficient research. From an advertisement relating to the matter, which appears on another page to-day, it will be seen that the firms acting in collaboration are the Alfred Appleby Chain Co., Ltd., Brampton Bros., the Coventry Chain Co., and Hans Renold, Ltd.

**Canadian Developments.**—The British firm of Baldwin's, Ltd., iron and steel makers, who are opening tinplate works in Canada, recently purchased British Forgings, the Canadian Imperial Munitions Plant at Toronto, which, according to the Swansea correspondent of the *Daily Telegraph*, possesses one of the finest ranges of electric furnaces in the world.

**Edison Electric Vehicle Works at Birmingham.**—As mentioned in our "Contracts Closed" column to-day, a works for the construction of electric vehicles is being established in the Birmingham district by MESSRS. EDISON ACCUMULATORS, LTD.

**Enfield-Ediswan Cable Works, Ltd.**—The business and other assets of the Enfield Electric Cable Manufacturing Co., Ltd., have been acquired by a new company formed under the above title, with a capital of £200,000. The Enfield Electric Cable Co. was the purchaser of the goodwill, plant, &c., of Messrs. Connolly Bros., Ltd.

**Catalogues and Lists.**—THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., Trafford Park, Manchester.—A number of new publications, illustrated and descriptive, have been issued as follows :—No. 86/8-3 dealing with oil-immersed motor control units for slip-ring type motors ; 332/1-1, relating to consumers' oil switch cubicle (type B) ; L344/2-3, showing D.C. ammeters and voltmeters, type R (moving coil). Two other leaflets give descriptive notes respecting round, sector and edgewise instruments shown on L344/2-3.

MESSRS. SIEMENS BROS. & CO., LTD., Palace Place Mansions, Kensington Court, London, W. 8.—Leaflet describing their chain-type cable hooks, and giving prices and illustrations of same.

MR. KENNETH HOGGAN, Stechford, Birmingham.—Priced leaflet containing specification particulars of the "Idobuff" polishing motor for D.C.

MESSRS. WOOD & CAIRNS, LTD., 5 to 9, Meuse Lane, Edinburgh. —Abridged monthly trade list (16 pages), tabulating particulars of a wide range of electrical accessories.

THE GENERAL ELECTRIC CO., LTD., Queen Victoria Street, London, E.C. 4.—Leaflet No. F 2224, giving brief illustrated particulars of their "Buoy" hand lamp.

MESSRS. PYRENE CO., LTD., 19-21, Great Queen Street, Kingsway, London, W.C. 2.—Illustrated circulars stating the special features of the Pyrene fire extinguisher, and setting forth its merits in dealing with electrical fires. A long list of electricity stations and other public and industrial users is given.

THE BRITISH ELECTRICAL AND MANUFACTURING CO., 2, St. Nicholas Buildings, Newcastle-on-Tyne.—Pamphlets dealing fully with their "Solum" aluminium solder. A report on tension tests is given, also instructions for use.

THE "EASY-FIX" FITTINGS CO., 66, Victoria Street, London, S.W.1.—Leaflet and List A describing the "Easy-Fix" conduit fittings, for the rapid fixing of switches, ceiling roses, &c., without screws.

**G.E.C. Launch Party.**—The G.E.C. travellers' launch party, consisting of a company of about 55, took place on June 21st. Mr. H. Hirst (chairman) and Mr. M. Railing (managing director) of the General Electric Co., Ltd., were present. Starting from Richmond on the *Richmond Belle* at 10 o'clock, Staines was reached about 3.30. Lunch and tea were served on board. The musical programme was carried on all day, and everyone assisted in making the trip a success. A good many interesting photographs were taken. Richmond was reached at 9.30 p.m. The last similar outing was held on Saturday, July 28th, 1914.

**New French Companies.**—Under the style of Le Fil Dynamo, there has been formed at Lyons a company with a capital of 500,000 fr., whose objects are the manufacture of electric conductors, wire and cables, bare or insulated.

Paul Forget et Cie. is the name of a company constituted at Paris for the supply of electric equipment for automobiles and other electric operations.

With the title of S.I.D.E. (Société Instruments de Précision et Dynamophare Eyquem), a company has been established at Paris, with a capital of 2,300,000 fr. for the manufacture and sale of scientific instruments and apparatus, and electric, telegraphic and telephonic apparatus, &c.

At Limoges Borde, Charbonniaud et Cie. has been constituted for the application and use of electricity in all its forms.

The Compagnie Générale Electrique de Nancy has been authorised to increase its capital to 15,000,000 fr. by the issue of 18,000 500-fr. shares.

**A Welding Inquiry.**—MR. C. A. STELLNER, 936, Mission Street, San Francisco, Cal., U.S.A., desires manufacturers to send him literature regarding quasi-arc welding equipments and on the welding of ships and barges, as he is going to teach welding in a Chinese shipyard.

**Trade Announcements.**—MESSRS. PAYNE GALLWEY, BROWN & CO., engineers, have recently reopened business at 49, Queen Victoria Street, London, E.C. The partners, both of whom have been demobilised, are J. Payne Gallwey, late Brevet Lieut.-Col., R.E., and Mr. C. L. Brown, A.M.I.E.E., Lieut., R.E. Both have been associated with mechanical, electrical, and colliery work for many years. The firm will act as manufacturers' agents for colliery, factory, &c., engineering supplies, plant, &c., for home and export. The staff consists of disabled officers only.

THE SOUTH OF SCOTLAND ELECTRICAL AND MECHANICAL ENGINEERING CO., LTD., have commenced business at 18, Rae Street, Dumfries.

MESSRS. POOLEY & AUSTIN have removed to 34, Broadway, Westminster, S.W. 1. Telephone number and telegraphic address unaltered. This change also refers to the London business of Mawdsley's, Ltd. ; F. & A. Parkinson, Ltd. : I. Frankenburg and Sons, Ltd. ; and Park Royal Engineering Works, Ltd.

MESSRS. F. HOWARTH and W. HOWARTH, who have recently been demobilised after service with H.M. Forces, are shortly recommencing business as electrical engineers at 18A, Market Street, Church.

THE ACME ELECTRIC TRACTION CO. have removed their office from Finsbury Pavement to Acme Works, Seven Sisters Road, Tottenham, N. 15.

**Plant for Disposal.**—The Disposal Board of the Ministry of Munitions invites offers for the hydraulic plant at Cleveland Steel Works, South Bank, Yorks. See our advertisement pages to-day.

**Catalogues Wanted.**—Electrical catalogues are wanted by MR. C. E. CAMBAGE, c/o Mr. J. E. Dyson, electrical engineer and contractor, Birhouse Lane, Crosland Moor, Huddersfield.

**Liquidations.**—RICHARD HORNSBY & SONS, LTD.—Meeting called for July 28th, at 75B, Queen Victoria Street, London, E.C. 1, to hear an account of the winding-up from the liquidators.

GEORGE SCHULTZ & CO., LTD.—Mr. D. F. Basden, 33, St. Swithin's Lane, London, E.C., has been appointed liquidator in place of Mr. W. A. Scott, who has resigned.

**Plant for Sale.**—Bexhill Corporation Electricity Department invites offers for two hand-fired water-tube boilers, with superheaters, &c. For particulars see our advertising pages to-day.

**Australian Industries.**—A resolution in favour of taxing imports with a view to the development of Australian industries has been passed by the Inter-State Labour Conference.—*Times.*

**Glover's Almanac.**—Coming at this season, "Glover's Almanac" (MESSRS. W. T. GLOVER & CO., LTD., Trafford Park) is always somewhat of a surprise—a welcome one. This is the 18th issue, a fact which indicates its sustained popularity; it is admirably produced, and undoubtedly represents a very considerable amount of thought and labour, the technical items being well-chosen and drawn from a wide range of sources. The Almanac will be found both useful and interesting.

**Platinum Mining in the Urals.**—According to a telegram from Omsk from the Minister of Commerce in Admiral Koltchak's Government, improvements in platinum mining in the Urals will result in a considerable increase in the output of this metal, which is likely ultimately to raise the rate of exchange of the rouble.—*Times.*

**The Late L.G.B.**—On July 1st all the powers and duties of the Local Government Board passed to the Ministry of Health, the question of the transfer to other Government Departments of any existing powers or duties not relating to matters affecting or incidental to the health of the people being reserved for consideration and decision at an early date.

**Visit of Brazilian Delegates to Osram Lamp Works.**—On June 26th, as we briefly mentioned in our last issue, the Brazilian Commercial Delegates paid a visit to the Osram Lamp Works at Hammersmith, where they were received by the chairman of the GENERAL ELECTRIC CO., LTD., Mr. Hugo Hirst. After the two kinds of manufactures at the works—*i.e.*, lamps on the one hand and wireless valves on the other, had been explained, the delegates were shown over the works, and the party then proceeded to Claridge's Hotel, where Mr. Hirst entertained them at luncheon. In the course of his speech, Mr. Hirst said he thought a great privilege to be able to entertain the Brazilian delegates in the dual capacity of member of the Federation of British Industries and as chairman of the General Electric Co., Ltd. Although at the Osram Works they manufactured practically only a speciality, the state of the works was a fair reflection of the state of the industry in this country. The stable side of the works—namely, the lamp-making—had remained stationary during the five years of the war; they had had neither labour, skill, nor building to expand to increase their output, or to make use of the suggestions and inventions of their expert staff. It was only now that they could make good, and building work was already progressing. They had lost little time since the Armistice, because they realised their task of catching up those fortunate competitors in America and elsewhere who did not suffer through the war—indeed, who even improved their positions. On the other hand, on the wireless valve side they could show something that owed its existence to the war. With the assistance of the Government, they had concentrated their energies on developing wireless valves, which had been most instrumental in the winning of the war. They were absolutely leading in this new industry. With the assistance of these valves, communication amongst the Allies became possible where all other means failed. With the assistance of these valves, the submarine danger received its death-blow. With the assistance of these valves, aeroplanes and ships could be brought safely into their landing places in the midst of fogs and darkness. These valves would be of particular interest in a country like Brazil, which was about to improve its means of communication.

He wished they had time to visit the other works of the General Electric Co., where they manufactured everything electrical. They had developed in such a manner that they were able to take on the biggest contracts in this or any country, and complete them with goods produced in their own works. They were taking a prominent part in helping to attain British supremacy in the electrical field in the same manner as it was attained on the battlefield. He was not one of those who doubted that this country was capable of rising to that position. He was not one of those who thought that the present unrest would lead to something more serious. He had never visited Brazil. It had been their privilege to fit up one of their principal mining companies (the St. John del Rey) with electrical plant for many years. They had supplied San Paolo Railway with a great deal of electrical material. But even had he known something of Brazil, after five years of war which isolated the different countries, and which imposed on every land the need of self-preservation and self-development, he was sure Brazil had changed to such an extent that a fresh study would be necessary. He was aware of their success in establishing textile and leather industries, and of their boundless store of raw material, of iron ore, of timber, of coffee, cotton, cattle, and rare earths, and he was aware of the need in Brazil of public utility concerns. This country had need of their raw materials, and was anxious to help them to develop them. It desired a share in the construction of their public utility undertakings, and their building up of means of communication, and in the supply of machinery for their industries. We should continue to be their best customer as in the past. The war had impoverished all nations so that they were short of money; what counted to-day was merchandise or raw material, not money. They would fare better by sending us their raw material in exchange for products which we manufactured, than buying those products, nominally cheaper for money, which was fluctuating in value, from countries which had no need for raw materials. With this in view, both we and they must try to develop the closest business relations, and increase the exchange of commodities between the British Empire and the great Republic of Brazil.

Dr. Souza Bandeira, replying, said that he was happy to have the opportunity of thanking the General Electric Co., Ltd., on behalf of the Brazilian Delegates, for the kindness with which they had been received at the Osram Works, and he hoped the commercial interchange between Great Britain and Brazil would be largely improved as the result of that visit. The Delegation would propose the formation of an Anglo-Brazilian Chamber of Industry and Commerce. They were highly delighted with the visit they had paid to the works and hoped Brazil would afford opportunities for exporting British manufactures. Dr. Roberto Cochrane Simonsen said they were grateful for the warm welcome they had received, and for the opportunity that the Federation of British Industries had given them of visiting many of the leading works in Great Britain. London was the greatest port in the world, and the greatest market. Brazil was the richest country in the world for waterfalls. They had 50,000,000 H.P., and that should provide the General Electric Co., Ltd., with good opportunities. He asked those present to drink to the future prosperity of the General Electric Co., Ltd.

Major-General the Hon. Sir Newton J. Moore, K.C., M.G., M.P., who responded on behalf of the directors, voiced their appreciation of the sentiments expressed by their guests. It had been a great pleasure to the company to have the opportunity of enabling their distinguished guests to see something of British industry, especially as far as their company was concerned. Their ambition was to take the place of the Germans. He thought that under the capable direction of Mr. Hirst, whose qualifications for leadership of such an organisation were recognised by the business community, not only in this country, but in all others, assisted by the loyal co-operation of his colleagues, the managers, and workmen, their aspirations might be realised.

**Book Notices.**—Congratulations to the proprietors of *Punch* on the production of a most excellent "Summer Number" (July 2nd, 1s.). Its contents are topical and largely of a Peace Celebration nature. The high reputation of the paper is well maintained.

The M. & C. "Apprentices' Magazine," summer number, contains an interesting article on the redistribution of the mineral resources of Europe under the Peace Treaty, by Mr. Sam Mavor, Reminiscences by Mr. Harry Edmunds, and a variety of other items. A new feature is "Coal-cutter Notes," a subject of special interest nowadays.

**The Ministry of Commerce.**—In the House of Commons on Monday, Mr. Bonar Law said it was the intention of the Government that the Board of Trade should be developed to perform all the functions of a Ministry of Commerce.

**Strike.**—According to the *Evening News* of Monday, 70 women were among the 250 employés at Messrs. Falk, Stadelmann and Co.'s electrical works, Farringdon Road, E.C., who struck work on that day, demanding that every warehouseman should join the union.

## LIGHTING AND POWER NOTES.

**Arbroath.**—STREET LIGHTING.—The question of gas *v.* electricity for street lighting is being considered, and it is to be ascertained whether an arrangement can be come to with the E.L. and P. Co. for partial lighting of streets previously lit with electricity.

**Australia.**—The decision of the Sydney City Council not to install a frequency changer, in connection with a supply of electricity from the Railway Commissioners' Power House at White Bay, was the subject of a deputation to the Council from the E.T.U., who feared a loss of employment, as unless additional power was made available before the winter of 1920, all extensions would have to cease by August next, with the result that about 800 men employed by the electrical contractors would be thrown out of work. The Mayor stated that the Council had given careful consideration to the case, and did not think it was possible for the frequency changer to be installed in the time mentioned by the deputation, also no definite agreement had been come to with the Railway Commissioners. The matter would be placed before the Lighting Committee for full consideration. He stated that the Council was shortly to consider a proposal to continue extensions in cases where energy would only be used between 8.30 a.m. and 5 p.m.; these extensions were possible through supplies of copper wire now being available from the Metal Manufacturers' Works at Port Kembla. The Council also was obtaining quotations for an 8,000-KW. turbo-generator, to be erected in time to cope with the winter load of 1920. Provided the plant could be erected by Messrs. Willans & Robinson in the time stipulated, an order would be placed with this firm. The Council in January last approved

of a recommendation to place the next order for a main generator with them, owing to the cancellation of the 5,000-KW. contract.

The Melbourne City Council is contemplating the expenditure of £330,000, spread over two years, on extensions of the electricity undertaking; £147,000 will be spent in 1920. The extensions will include a sub-station, and the changing over from D.C. to three-phase.

The Stephens Shire Council (Queensland) has made application for an Order in Council authorising the Shire Council to purchase electricity in bulk for power and lighting, and for a loan of £15,000 to finance the scheme.—*Tenders.*

**Aylesbury.**—WORKS SUPPLY.—The T.C. has decided to supply energy to the ink works of Messrs. Hazell, Watson and Viney, at a flat rate of 1·85d. per unit, but the firm has been approached with a view to accepting alternating current at 1·75d. per unit, with a coal clause.

**Bacup.**—LOAN APPLICATION.—The Electricity Committee has decided to apply to the L.G.B. for sanction to the borrowing of £5,000 for the extension of mains and services.

**Ballymote (Co. Sligo).**—PROPOSED E.L. SCHEME.—A company is being formed for the introduction of public electric lighting.

**Bandon (Co. Cork).**—PROPOSED E.L. SCHEME.—The scheme proposed for the electric lighting of the town is now under the consideration of the Bandon Town Commissioners.

**Barnes (Surrey).**—CONTRACT DEMAND SYSTEM.—The U.D.C. has decided not to replace the older type of prepayment meters, owing to the cost of new ones, but to extend the contract demand system at present in use at workmen's dwellings, and the price of energy is to be increased to 3d. per week for 20 watts demanded, the first war-time advance. Charges made for laying services to premises within 20 yards of any distributing mains since April 17th, when borrowing was sanctioned by the L.G.B., are to be returned to the consumers.

**Bolton.**—Repairs following upon the recent serious fire at the Spa Road generating station have now been effected.

**Bingley.**—YEAR'S WORKING.—The balance-sheet of the electricity department shows a loss on the past year's working. The loss on revenue account was £876, the total loss, including interest and sinking fund payments, being £1,637. The chairman of the Committee said he estimated, through a revision of the agreement for power charges for the tramways of the Bradford Corporation, and the latest increase in lighting and power charges, an increase of £600 in the revenue for next year.

**Burnley.**—LOAN APPLICATION.—The T.C. has decided to apply for sanction to borrow £2,500, for additional boiler plant, &c., at the Corporation electricity works, in order to meet the increasing demands. In addition, it is proposed to borrow £5,000 for purposes of cable extensions, which, it is estimated, will cover the next two years.

**Burton-on-Trent.**—YEAR'S WORKING.—The annual report on the electricity undertaking for the year ended March 31st last shows that the surplus was the highest on record, amounting to £5,258, compared with £3,313 last year. Revenue amounted to £34,955; working expenses, £21,256; interest, repayment of loans, contribution to capital expenditure, &c., £8,441. The surplus is appropriated as follows:—Capital expenditure in lieu of borrowing, £2,062; relief of rates, £1,000; renewals fund, £2,196. Income shows an increase of £7,751 compared with the preceding year, extra income due to war charges being £10,094. Costs compared with 1915 have increased by £13,669. The cost per unit sold has increased by 0·197d. per unit, or 22 per cent., and as the costs now exceed 1d. per unit, there will be no payment to employés this year under the profit-sharing scheme. Total units sold amounted to 4,837,740, an increase of 10·06 per cent. The plant capacity is now 3,900 KW., and the load factor 26·3 per cent.

**Cannock.**—The Council has regained the power it formerly possessed in respect of electric lighting in the district. The seal of the Council was affixed to the deed of transfer from the Shropshire, &c., power company to the Council of the undertaking under the Council's Electric Lighting Order, 1901. The Council some years ago ceded its powers to the company, receiving a payment of £500 as a recompense.

**Cavan.**—PROPOSED E.L. SCHEME.—A public meeting decided to form a company for the electric lighting of the town, with a capital expenditure estimated at £6,000 and running expenses at £800 per annum.

**Coleraine.**—PROPOSED E.L. SCHEME.—At a special meeting of the Urban Council last week, the clerk submitted the report and estimate prepared by Mr. Thomas, A.M.I.E.E., Londonderry, on the proposed electrical scheme for the town. The report gave the capital sums for three schemes:—Suction gas type of plant, £22,000; steam, £20,500; and water and suction gas, £24,500. As regards revenue, assuming charges equal to present rates—8d. for shop lighting, 6d. for house lighting, and an average of 2d. for power—the annual revenue, assuming shop lighting equal to house lighting, would be £4,900. If they were able to secure the lighting and power for mills and factories, it would mean an additional outlay of £21,500, making the capital cost of the water and suction gas scheme, which he considered the best, £46,000. The matter was deferred till the members should have an opportunity of discussing the report.

**Continental.**—SWITZERLAND.—At the last convention of the Swiss Association of Water-Power Engineers, at Basle, plans were brought forward for installing new power stations on Swiss soil in the regions of the Rhine, Reuss, Limmat and Aare. The projects include no fewer than 24 power stations with an aggregate of 300,000 H.P., with possibilities for extension to 1 million H.P.

SPAIN.—A concession has recently been granted for the establishment of plant to utilise the water power of the river Seguro, near Alcantarillo de Jover, to generate electricity for lighting and power purposes.

FRANCE.—The Conseil Général of the Yonne Department has approved of the project for setting up three hydro-electric works on the River Cure, capable of supplying electricity to the whole of the Department and also to the neighbouring Departments.

The Conseil Général of the Alpes Maritimes is now engaged in studying the ways and means of speedily utilising, preferably on the spot, all the hydraulic power of the Department. To this end, technical and financial schemes have been invited from all the leading manufacturing industries, which are to be forwarded to a Commission sitting at Nice.

SWEDEN.—Among the new companies recently formed to establish central electric lighting stations and distribution plants are the Aktiebolag Sarna Elektricitet, Sarna; the Aktiebolag Sanderyds Elektriskaverk, Sanderyd; the Ballingslovs Elektricitet Aktiebolag, Bahlingslov; and the Halsinglands Elektriska Aktiebolag, Hudiksvall.

A company has lately been formed at Lit with the title of the Lits och Kyrkes Elektriska Aktiebolag, to undertake the distribution of electrical energy for lighting and power purposes in the two towns.

**Croydon.**—PROPOSED EXTENSIONS.—The T.C. has instructed the borough electrical engineer to prepare plans for the reconstruction of the generating station.

LOAN SANCTION.—The T.C. has received sanction to a loan of £9,500 for electricity mains.

**Dublin.**—NEW POWER RATES.—The decision of the Corporation restricting the operation of the new electricity power rates to 12 months—to the end of the June quarter, 1920—was based on the following reasons:—"That by the end of 12 months a more settled condition of working will enable the Council, in all probability, to make a reduction in the rates which are now necessary; that the new Municipal Council which will be elected in January, will, before the end of June, 1920, have time to consider the position of the electricity undertaking; and that by that time the Council will be in a position to judge how far the undertaking is likely to be affected by the proposal of Government control made in the Electricity Supply Bill."

**Dundalk.**—PROPOSED LOAN.—The U.D.C. has approved of an increase in the loan, for which the L.G.B. sanction is to be sought, from £2,000 to £3,000, the addition being required to meet extension of underground mains. A sum of £500 will be needed for new service connections during the next three years.

**Edinburgh.**—PORTOBELLO.—At a meeting of the T.C. the amended scheme for the sea work at Portobello power station submitted by the Corporation Electric Lighting Committee, which recommended that a new contract with Messrs. Charles Brand and Son for the work be entered into, was criticised. It was pointed out that as late as March the estimate was £38,000, and now it had become £89,000. It was explained that the Corporation had sent in a claim to the Government in regard to the increased cost now of this work, which could have been done but for the Government stopping it owing to the war. That claim had been recognised by the Board of Trade.

**Egham.**—MAINS EXTENSION.—The E.L. Co. has informed the U.D.C. that it is prepared to extend the mains to various parts of the parish, provided £1,450 is contributed towards the cost. The Council has asked the company for terms for public lighting where mains are laid.

**Ellesmere Port.**—PROV. ORDER.—Hooton and Ellesmere Port Electric Supply Co. has informed the U.D.C. that it is applying for a prov. order, and the Mersey Power Co. has applied to the B. of T. for permission to supply electricity to the works of the Ship Canal Portland Cement Co. The U.D.C. has decided to oppose the latter application.

**Faversham.**—PRICE REVISION.—Under powers contained in a B. of T. Order, the T.C. has decided to advance the price of energy for lighting from 7d. to 9d. per unit as from August 1st next.

**Fleetwood.**—PRICE REVISION.—The U.D.C. has decided to increase the charges for electricity to 7d. per unit for the first 500 per quarter for lighting purposes, 6½d. per unit for the next 500, and 6d. per unit afterwards; for power purposes 3d. per unit for the first 500 units, and 2½d. per unit afterwards.

**Halifax.**—YEAR'S WORKING.—There is a profit of £9,609 on the working of the electricity undertaking for the year ending March 31st, compared with £12,283 for the previous year.

**Hebden Bridge.**—ADDITIONAL BULK SUPPLY.—The U.D.C. has decided to ask the Halifax Corporation for a quotation for a bulk supply of electricity over that provided by the existing agreement, to be on the basis of a flat rate rather than a maximum demand.

PRICE REVISION.—The charges for electricity for power purposes are to be increased 10 per cent., and the scale of discounts applicable to power consumers is to stop at 60 per cent. instead of 62½ per cent., as at present.

**Honiton.**—STREET LIGHTING.—The T.C. has decided in future to light the streets by electricity, on the ground of economy.

**Highley (Bridgnorth).**—E.L. SCHEME.—A meeting of parishioners has been held to consider the question of lighting the village by electricity, power for which would be obtained from the Borle Mill, ¼ mile distant. It was estimated that the cost of the scheme would be £4,400, excluding the wiring of houses. The total expenditure would be £6,000, and it was estimated that there would be an income of £1,040 and an expenditure of £600 per annum, including interest on borrowed money. The matter is to be further discussed.

**Houghton-le-Spring.**—PRICE REVISION.—The E.L. Co. announces that the price of energy for lighting is to be increased by a further 30 per cent., and for heating by 10 per cent., from July 1st. The U.D.C. has asked the company for an explanation of the increases.

**Hull.**—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking for the year ended March 31st last show total income £144,369, an increase of £24,634; working expenses, £105,258; gross profit, £39,110. After meeting sinking fund and other charges, there is a deficit of £2,534.

**Irlam.**—PROPOSED E.L. SCHEME.—At a meeting of the D.C., last week, the question of electric lighting was referred to, and the clerk was instructed to write to the Partington Steel and Iron Co., Ltd., in regard to the tentative arrangements they were considering with the Council for the supply of electricity to the district in bulk, when the negotiations were suspended owing to the war.

**Leeds.**—YEAR'S WORKING.—The annual report on the electricity undertaking for the year ended March 31st last, shows that the total units sold (62,387,433) were 0·61 per cent. less than in the previous year, due to the falling-off of 382,218 units, or 5·34 per cent. in the sale of energy to the tramway department. The number of consumers increased by 5·49 per cent.; sales for power increased by 0·28 per cent. to 46,990,861 units, and total KW. taken by motors increased by 8·14 per cent. to 51,799 KW. The number of users of electric light increased by 5·38 per cent. to 12,136, but energy sold for street lighting was about one-fifth of the pre-war sale. The number of consumers of electricity for heating purposes grew by 12·25 per cent. to 1,685, but the increase in units sold was only 0·72 per cent., or 8,445 units. Under the heading of residential bulk supplies the number of consumers has decreased by 43, and the units sold by 201,800, or 26·97 per cent. Income shows an increase of £55,580, or 20·4 per cent., and expenditure £58,383, or 22·3 per cent.; the profit as compared with the previous year is, therefore, reduced by £2,803. Out of the profit (£6,866) a sum of £6,217 has been contributed to the cost of permanent works, leaving a surplus of £649, against £277 last year. Working expenses per unit sold were 0·72d. against 0·52d., and capital charges 0·45d. against 0·42d.

The maximum load fell from 24,920 KW. in 1917-18 to 23,130 KW. in 1918-19. No additional generating plant was installed during the year; two more engines and alternators with a capacity of 1,400 KW. each, erected in 1905, have been sold to make room for a 6,000-KW. turbo-alternator, placed on order, this being a duplication of the operation reported a year ago. The capacity of the station is thus momentarily reduced from 41,800 KW. to 39,000 KW., with a further 12,000 KW. on order in the form of two turbo-alternators of 6,000 KW. each. Contracts have been let during the year for extensions of the boiler house and other buildings, and for the erection of two additional boilers. A coal wharf and land adjoining the generating station, comprising an area of 1,730 sq. yards, have been purchased during the year at an inclusive cost of £5,566.

**Leigh.**—COLLIERY ELECTRIFICATION.—Important electrical developments, which were greatly retarded during the war, have been completed at Messrs. J. Speakman & Sons' Woodend Collieries, Bedford, Leigh.

**London.**—HAMPSTEAD.—YEAR'S WORKING.—The report of the year's working to March 31st of the electric lighting undertaking shows net income £76,199; expenditure, £60,030; gross profit, £16,169. Interest and repayment charges totalled £29,313, special expenditure £4,202, leaving a deficit on the year's working of £20,345 as compared with £6,398 the previous year.

STEPNEY.—LINKING UP.—The Council has been notified that the B. of T. has approved of the draft of the new linking-up agreements with Poplar and Shoreditch B.C.'s.

MARYLEBONE.—YEAR'S WORKING.—The accounts of the working of the electricity department to March 31st last show total income £254,156; total expenditure, £134,706; gross profit, £110,449; after making provision for interest, repayment, and other charges, amounting to £111,452, there is a loss on the year's working of only £1,003, although the output has decreased by 2,142,135 units, the total units sold being 16,245,133 against 18,387,268 for 1917-18.

**Mansfield.**—EXTENSIONS OF SUPPLY.—The T.C. has decided to apply to the B. of T. for an order extending the area of supply to Sutton-in-Ashfield, Kirkby-in-Ashfield, and Huthwaite. The Sutton U.D.C. has appointed a deputation to wait on the Corporation with reference to the matter.

L.G.B. INQUIRY.—A L.G.B. inquiry was held on June 18th relative to the application of the T.C. for a loan of £32,000 for additional plant and buildings in view of the extended area of supply and the tramways. There was no opposition.

**Navan.**—FIRE.—By the destruction by fire of Messrs. Spicers' flour mill, Navan, Co. Meath, entailing a loss of some £20,000, the town has lost its electricity supply, which came from the mill.

**Newry.**—E.L. SCHEME.—Mr. A. E. Porter, consulting engineer, Dublin, reported to the U.D.C. that in his opinion the use of water-power for the proposed electrical scheme was not practicable, and that a scheme worked in connection with the gas department would be more economical. His estimate of capital cost was £15,026.

**Pembroke (Co. Dublin).**—PUBLIC LIGHTING.—The U.D.C. received a report that the Alliance and Dublin Consumers' Gas Co. was willing to sell the existing lamps for £1,080, which would facilitate their conversion to electric lamps. It was said the cost of lighting the district by electricity would be about £2,500, but the change would mean an annual saving of £900.

**Peterborough.**—YEAR'S WORKING.—On the electricity undertaking during the year ended March 31st last there was a surplus on the working account of £3,515, but, taking capital and special charges into consideration, there was a deficit of £1,440. In the previous year the corresponding deficit was £560.

PRICE INCREASE.—It has been decided to increase the charge for energy for lighting from 6·3d. per unit to 7d. (6½d. over 500 units per quarter); to add 40 per cent. for power, making the charge from 1·35d. to 2·7d. per unit, according to quantity used, and to increase all special rates.

**Salford.**—PRICE REVISION.—The Electricity Committee recommends the Council to increase as from September 30th the price of electricity as follows:—From 30 to 50 per cent. for lighting and from 50 to 75 per cent. for power and heating, including bulk supplies.

**Sale.**—L.G.B. INQUIRY.—A L.G.B. inquiry was held recently into the application by the U.D.C. for sanction to borrow £8,000 for extending the plant at the electricity undertaking.

**Sandgate.**—E.L. CHARGES.—The U.D.C. has decided to pay the extra charge of 15 per cent. for current asked for by the Folkestone E.L. Co.

**Shipley.**—PRICE REVISION.—The U.D.C. has advanced the charge for electricity for lighting to 8d. per unit; for small power users, for heating, cooking, &c., a flat rate of 3d. per unit; for large power users increases on a proportionate scale. The new rates apply from July 1st.

**Skibbereen (Co. Cork).**—PROPOSED E.L. SCHEME.—A special meeting of the shareholders of the Gas Co. was recently held to consider the advisability of extending the company's operations to include the supply of electricity for the public lighting of the town. It was stated that the company was compelled to take this course by reason of the fact that the normal consumption of gas had exceeded the output capacity of the plant. To meet the demand a large capital outlay would have to be incurred in increasing plant and storage capacity. It had, therefore, been decided that the correct procedure to adopt would be to continue to supply gas for power and domestic purposes with the existing plant, and to install electrical plant for lighting, which would relieve the company of dependence on sea-borne coal from Great Britain. Resolutions were adopted empowering the company to proceed on the lines indicated.

**Stirling.**—PROPOSED LOAN.—The T.C. is to ask the Secretary for Scotland for authority to borrow £6,500 in respect of the installation of condensing plant and the extension of the mains in connection with the housing scheme.

**Stoke-on-Trent.**—L.G.B. INQUIRY.—The L.G.B. has held an inquiry into the application for sanction to the borrowing of £4,500 for a low-tension feeder to the California Works of Kerr, Stuart & Co.; and for sums aggregating £13,440 in respect of extensions of service mains, &c.

YEAR'S WORKING.—The total income of the electricity department for the past year amounted to £81,650, and the expenditure to £60,750. After allowing for interest, loan repayment, and sinking fund charges, there is a net loss on the year's working of £3,649.

**Todmorden.**—PRICE REVISION.—Owing to the increased cost of production, the Corporation has advanced electricity charges about 70 per cent.

LOAN APPLICATION.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £7,500 for electricity purposes.

**Trowbridge.**—The U.D.C. has refused permission for the E.L. Co. to use overhead lines in Union Street for the transmission of energy, and adheres to its resolution for underground cables.

**Walkden.**—In connection with the big extensions which Messrs. Burgess, Ledward & Co. are carrying out at Wardley Mills, Walkden, it is stated that powerful electrical installations are to be put down.

**West Hartlepool.**—L.G.B. INQUIRY.—Colonel T. C. Ekin has held an inquiry respecting the application made to the L.G.B. by the Corporation for sanction to borrow £34,400 for the municipal electricity works. The town clerk explained that £23,580 was required in connection with the linking-up agreement between the Corporation and the Cleveland and Durham County E.P. Co., by which an additional supply of energy would be obtained from the company, whilst the Corporation would supply to the company energy generated by waste heat from the Seaton Carew blast furnaces at periods of low demand. A proportion of the money is required for distribution cables, the present ones being overloaded.

**Weymouth.**—PRICE REVISION.—The T.C. has adopted the following revised charges from July 1st:—Lighting, 8d. per unit, with discounts as under: 5,000 units per quarter, 40 per cent.; 3,000, 25 per cent.; 2,000, 15 per cent.; 1,500, 12½ per cent.; 1,000, 10 per cent.; 750, 7½ per cent.; 500, 5 per cent.; 250, 2½ per cent.; below 250, net. Power, 2½d. per unit, with discounts: 10,000 units per quarter, 10 per cent.; 5,000, 5 per cent.; below 5,000, net. Fixed-price light consumers, increase of 10 per cent.; contract-rate consumers, increase 10 per cent., plus ½d. per unit net.

## TRAMWAY AND RAILWAY NOTES.

**Blackpool.**—The receipts on the Corporation tramways since April 1st, show an increase of £3,200 on last year, the average receipts per car-mile being 2s. 2¾d. A 50 per cent. increase on the circular tour fares resulted in the remarkable average of 4s. 3¾d. per mile on this section.

**Bradford.**—YEAR'S WORKING.—The total revenue during the past year of the Corporation tramways was increased to the extent of £93,000, but working expenses have expanded, falling short of the increase in revenue by only £33,000. Net profits show the record figure of £60,819, compared with £31,372 during the preceding year.

**Brighouse.**—LINKING UP.—There is every possibility of the Huddersfield Corporation tramway system being extended to Brighouse before very long, and Huddersfield, Brighouse, Halifax, Bradford, and Leeds will then be linked up. The Mayor of Brighouse last week reported to the T.C. that it was likely that the Huddersfield cars would come to Rastrick at an early date, but on account of the extraordinary expenses attached to the project, the Huddersfield Corporation was, naturally, desirous of effecting every possible economy. The Mayor said Huddersfield was anxious to introduce a Bill into Parliament at the earliest possible date, and he hoped cars would be at Rastrick before 12 months were out.

**Continental.**—ITALY.—The electrification of the Turin-Cirié-Valli di Lanzo Railway has been taken in hand, the Italian Brown-Boveri Co., of Milan, being the contractors. The delay has been owing to indecision with regard to the system to be chosen, and it has now been decided to use D.C. at 4,000 volts.

The Italian Budget estimates for 1919-20 include a sum of 17,000,000 lire for new electric tramways.

The Società Anonima Trazione Elettrica Lombardo has been launched, with a capital of 2,000,000 lire, for the construction, working, and acquisition of steam and electric tramways and railways.

The various communes interested have decided to apply for Government authority to lengthen the electric tramway from Perosa to Fenestrelle, after having come to the conclusion to contribute 300,000 lire towards the outlay for construction.

The construction of a funicular electric railway from Castellamare di Stabia to Quisiana is among the projects contemplated in the near future by the municipality of the former town.

FRANCE.—An important electric railway undertaking is about to be taken in hand in the Ardeche region—namely, the Le Puy to Lalevade d'Ardeche line, mooted some time since. A new track is being surveyed, with steeper gradients, in view of the use of electric power.

A funicular railway is under consideration to join the Vals-les-Bains (Ardeche) station to the Sainte Marguerite plateau, the line to be electrically worked. It will prove a great addition to the attractions of this tourist resort.

A new electric tramway line in Upper Savoy is talked of to link Annecy-Thornes, Entremont, Petit Bornand, and Bonneville, with a branch to the existing Annemasse line. Local communes will subscribe a subsidy of 300,000 fr.

A survey, with a view to the complete electrification of the tramways of the Department de la Correze, has been ordered.

**Glasgow.**—SEMI-JUBILEE CELEBRATION.—Arrangements are being made for celebrating the semi-jubilee of the T.C. tramway department. It has been decided that each employé, including workers of the salaried staffs, be paid an extra day's wages, and that an inspection by the T.C. and former members of the Committee be made of the works of the department at Coplawhill, followed by a luncheon.

**Hyde.**—YEAR'S WORKING.—It was stated at a meeting of the Stalybridge, Hyde, Mossley, and Dukinfield Joint Electricity and Tramways Board that the tramway revenue was the highest on record, showing an increase of £9,000. Practically the whole amount paid by the four Corporations in precepts had been passed to the renewal fund. The arbitration regarding the purchase of the Hyde tramways was fixed for October. The receipts of the electricity department showed an increase of £16,000 over last year, and the profits were £3,000 more.

**Lancaster.**—FARE INCREASE.—Owing to the increased wages of the tramway employés, it has been decided to advance the fares 50 per cent.

**London.**—L.C.C.—The annual accounts of the working of the Council's tramways for the year ended March 31st, show total revenue receipts £3,578,256, as compared with £2,932,140 for the previous year, the gross profit being £719,842; after allowing £690,003 for interest and sinking fund charges, and £21,770 for other expenditure, there is a net profit of £8,069, which has been carried to the renewals fund. The balance available for renewals fund compares with the original estimate of £12,115, and the revised estimate of £50,321; the surplus realised in 1917-18 was £99,559. The net capital expenditure in 1918-19 amounted to £34,143, and the total capital expenditure to March 31st, £13,693,752. The total debt incurred to that date was £14,022,835. The debt outstanding was £8,470,034; deducting the value of surplus lands, the net debt was £8,349,818. £5,552,801, or 40 per cent. of the total debt incurred, had been paid off. Renewals fund expenditure for the year was £80,156, leaving a balance on March 31st of £261,413; reserve fund balance, £76,791. Passengers carried, 636,157,361, as against 593,516,141 the previous year; car-mileage 48,052,201 miles, as against 49,189,886 miles; passenger receipts per car-mile 17·87d., as against 14·30d.; working expenses per car-mile 14·27d., as against 10·38d.

The estimated results for 1919-20 are as follows:—Total receipts, £4,475,000; total working expenses, including war allowances and £10,000 for contingencies, £3,531,925; surplus on working, including interest on bank balances, &c., £962,461; after deducting repayment (£426,833), interest (£252,840), and income-tax (£70,221) charges totalling £749,894, the estimated surplus to be transferred to renewals is £212,567. It is estimated that the passenger receipts on an estimated car-mileage of 53,000,000 will average 19·88d. a car-mile, and that working expenses will amount to 15·59d. per car-mile.

The Highways Committee's report states that the result of working the Council's tramways during the five years 1914-15 to 1918-19 has been that, taking into account the sums actually expended on renewals and after providing for loan and other charges, there has been a total deficiency of about £420,000, which has been met out of the balances of the general reserve and renewals fund. No contribution has ever been made from the rates in aid of the tramway undertaking.

**Manchester.**—YEAR'S WORKING.—The report of the working of the Corporation tramways for the year ended March 31st last shows traffic receipts £1,359,391, as against £1,108,164 the previous year. Total receipts amounted to £1,369,609, as against £1,119,861; working expenses, £681,401; war service allowances, bonuses, &c., totalled £287,988; gross profit, including bank interest, £418,080, as against £348,078; after providing for loan and other charges, there remained a net profit of £250,427, which has been allocated as follows:—£110,596 to renewals fund, £27,940 for income-tax, and £111,891 to relief of rates. Number of passengers carried 253,940,203, or 48 million in excess of pre-war figures.

**New District Railway Trains.**—The Underground Railway Co. has under construction a new type of car, which it is hoped will considerably alleviate the present congestion during rush hours. The new District trains will be composed of eight cars in all. The cars will be wider, and the trailer cars will be fitted with three double sliding doors, each wide enough for two passengers to enter or leave the car at one time. On the motor-cars and control trailer cars, in addition to the three double doors, single doors are fitted at the ends of the cars which will be available for the use of passengers, when not occupied by the train staff. On an eight-car train there are 52 single doors for the use of passengers entering or leaving the train. New cars will be put into service as soon as delivered.

**Oldham.**—The Corporation is purchasing 12 additional tramcars. Delivery is promised within six months.

**Women Conductors.**—The Ealing Comrades and Federation of Ex-Service Men have passed resolutions protesting against the employment of women on tramcars and in the public services.

## TELEGRAPH AND TELEPHONE NOTES.

**American Cables.**—The Telegraph Construction and Maintenance Co., London, has completed the first 500 miles of cable for the Central and South American Cable Co.'s Brazil-Argentina connections—Rio de Janeiro to Buenos Aires, and Santos to Buenos Aires. These cables will be laid and in operation before the end of the present year.

**Automatic Telephones.**—The Hull Corporation Telephone Committee has approved a scheme for the installation of an automatic telephone system, with a new district exchange at Hull, at an estimated cost of £58,786, and is making application for sanction to borrow the necessary amount.

**Cable Delays.**—The *Financial Times* says that it still takes 16 days for a cable dispatched from the United Kingdom to reach Sydney or Melbourne, and six days for the reply to get back!

**Cable Rates.**—The Eastern Telegraph Co. announces that the tariff for telegrams between the United Kingdom and Hong-Kong, China, Japan, and the Philippines will be reduced by 6d. per word, as from September 1st.

**Japanese Cable.**—It is reported from Tokio that a number of Japanese business men have decided to form a Japan-America Submarine Cable Co. to lay an additional cable across the Pacific Ocean. It is stated that the company will have a capital of $25,000,000, and will seek a subsidy from the Japanese Government.—*T. and T. Age.*

**Lapland.**—At Porjus, in Lapland, wireless telegraphy is to be put to local use for maintaining communication between working centres while the regularisation of the Lule River is proceeding. Telephone and telegraph lines in these mountainous districts are often destroyed by snowstorms and avalanches.

**Post Office Mail Tube.**—Mr. Illingworth, replying to a question in the House about the Post Office mail tube, said the running tunnel had been completed, but until further progress had been made with the remainder of the work, including the electrical plant, he could not say when the railway would be open for traffic. He did not propose to consider the construction of any further underground railways for the conveyance of mails until experience had been gained of the actual working of the railway now being constructed.

**Telegraph and Telephone Deficiency.**—Mr. Illingworth stated in the House of Commons that the commercial accounts for the year 1917-18 showed a deficiency of £556,330 in respect of the telegraph service, and a surplus of £355,468 for the telephone service. In both cases the balance was arrived at after providing for interest on the capital value of the plant and buildings, and for pension liability and depreciation of plant. The accounts for 1918-19 would be much less favourable, owing to the largely-increased war bonus paid to the staff, amounting to £1,250,000 for the telegraph service, and to nearly £1,500,000 for the telephone service, and the loss on the two services would be about £1,000,000 on telegraphs and £400,000 on telephones. The deficiency would be substantially larger for 1919-20. The war bonus was estimated at over £2,000,000 for the telegraph service, and about £2,500,000 for the telephone service. In addition, the cost of materials had increased, and the charges for pension liability and depreciation would be higher. He was considering the question of increasing the rates charged to the public.

**United States.**—The Postmaster-General informed the Committee of the Federation of Labour, who had asked him to give instructions for the re-employment of the telegraphists who struck a few weeks ago, that he was unable to comply with their request, as he considered that the strikers had violated the rules of the Government for the regulation of labour during the war. He added that the decision with regard to re-employment rested wholly with the managers of the telegraph companies concerned.

# CONTRACTS OPEN AND CLOSED.

*(The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

## OPEN.

**Australia.**—SYDNEY.—August 27th. N.S.W. Railways and Tramways Department. Three-phase induction motors. Chief Electrical Engineer, 61, Hunter Street, Sydney.—*Tenders.*

**Bedford.**—July 14th. Electricity Committee. One 1,500-KW. 1-phase turbo-alternator and condensing plant, boilers, superheaters, mechanical stokers and induced draught plant, E.H.T. switchgear, water softener, feed-water heater and storage tanks, water-measuring apparatus, feed pumps. (June 20th.)

July 21st. Electricity Committee. Buildings, electric motors, &c., coal conveyor, runaway and chutes. (June 27th.)

**Birkenhead.**—July 28th. B. of G. Installation of internal telephones. (June 6th.)

**Colne.**—July 4th. Electricity Department. Supply, drawing-in and jointing of approximately 2,200 yd. ·05 sq. in., 3,300-volt, 3-core cable. (June 20th.)

**Croydon.**—July 10th. Education Committee. Repairs to E.L. installations, Council Schools. Mr. Jas. Smythe, Clerk, Katharine Street.

**Darlington.**—July 11th. Electricity Department. Rotary converter, cooling tower, water-tube boiler, economiser, and induced draught fan. (June 20th.)

July 16th. Lead-covered and armoured cables. (See this issue.)

**Gravesend.**—July 12th. Electricity Department. One 2,000-KW. turbine with 6,000/6,600-volt 3-phase alternator, condenser with motor-driven air and circulating pumps. (June 20th.)

**Hammersmith.**—The B.C. is inviting fresh tenders for the supply of an air heater, ducts, fan and turbine.

**Nuneaton.**—July 15th. Electricity Department. 1,350 yd., ·6 × ·1 × ·6, three-core, paper-insulated, armoured feeder cable, feeder pillar, distributors, link disconnecting joint-boxes, &c.

**Paris.**—July 10th. Administration des Postes et Télégraphes. Supply of multiple commutator switchboards. Particulars from Direction de l'Exploitation Téléphonique, 4, Bureau, 103, Rue de Grenelle, Paris.

**Redditch.**—July 28th. U.D.C. High-pressure steam, exhaust and water-circulating piping. (See this issue.)

**Salford.**—July 7th. Electricity Department. Coal for 12 months for electricity department. Borough Electrical Engineer.

**South Africa.**—THE STRAND, CAPE PROVINCE.—July 31st. Municipal Council. Material and plant for the electric lighting of the municipality. Town Engineer.

**Tasmania.**—LAUNCESTON.—July 28th. City Council. Sub-station equipment, battery, reversible booster, switchgear, &c. City Electrical Engineer.

## CLOSED.

**Aylesbury.**—T.C. :—

Extra-high-tension cable.—The Enfield Co.
Water softener.—Paterson Engineering Co., £75.

**Birmingham.**—Corporation. Salvage Department. Edison Accumulators, Ltd., London. 25 electric-motor dust-collecting vehicles.

It is stated that the Edison Co. is establishing works in the Birmingham district, in which the vehicles will be constructed.

**Bradford.**—Electric wiring at the St. Luke's Hospital. Messrs. Smith & Croft.

**Glasgow.**—Tramways Committee. Recommended :—

Trolley wire.—Fred. Smith & Co., Ltd.
Cable.—B. I. & Helsby Cables, Ltd.
Repairing chimney stalk, Pinkston.—C. Kippen.
Dry cells.—Siemens Bros. Dynamo Works, Ltd. and Western Electric Co., Ltd.
Axles.—Glasgow Railway Engineering Co., Ltd.

Supply of 5,000 tons of rails :—

| | | |
|---|---|---|
| **United States Steel Products Co.** (recommended) | (delivery July, Aug., and Sept.) | **£17** per ton |
| Bolckow, Vaughan & Co. (Sept. to Dec.) | | 19 ,, |
| P. & W. M'Lellan, Ltd. (Sept. to Dec.) | | 19 ,, |
| Walter Scott, Ltd. (Oct. to Dec.) | | 20 ,, |

Electricity Committee. Recommended :—

D.C. ampere-hour meters.—Chamberlain & Hookham, Ltd.; Ferranti, Ltd.
D.C. watt-hour meters.—Aron Meter, Ltd.
A.C. meters.—British Westinghouse Co., Ltd.

**Hammersmith.**—Electricity Committee. Recommended: 250 yd. ·2 sq. in., and 500 yd. ·05 sq. in. L.T. cable :—

| | 250 yd. ·2 sq. in. | 500 yd. ·05 sq. in. |
|---|---|---|
| **Western Electric Co., Ltd.** (recommended) | **£124** | **£114** |
| B. I. & Helsby Cables, Ltd. | — | 118 |
| W. T. Henley's Telegraph Works Co., Ltd. | 126 | 116 |
| Callender's Cable & Construction Co., Ltd. | 127 | 115 |
| Pirelli-General Cable Works, Ltd. | 131 | 114 |
| Macintosh Cable Co., Ltd. | 138 | 130 |

**Leyton.**—Electricity Committee. Recommended :—

Two 500 KW. motor converters, £6,125.—Bruce Peebles & Co., Ltd.

**Lincoln.**—T.C. :—

Boiler plant.—Babcock & Wilcox, Ltd.
Turbo-generators and Allen's condensing plant.—B.T.H. Co., Ltd.
Switchboards.—Ferguson, Pailin, Ltd.
Rotary converters.—Vickers, Ltd.
Transformers.—Brush Electrical Engineering Co., Ltd.

**Mansfield.**—B. of G. Electrical work for three months. Mr. G. Cooper.

**Peterborough.**—T.C. :—

10-in. centrifugal pump, 45-H.P. motor and starting panel, £355 .. .. .. .. Gwynnes, Ltd.
**9-in. do., 40-H.P. motor, &c., £295** (accepted) **Gwynnes, Ltd.**
10-in. do. 35/40-H.P. motor, &c., £323 .. English Elec. Co., Ltd.
10-in. do., 45-H.P. motor, &c., £323 Rees Roturbo Mftrs. Co., Ltd.
10-in. do., 35-H.P. motor, &c., £340 .. Mather & Platt, Ltd.

**Stepney.**—Electricity Committee. Accepted :—

| | | |
|---|---|---|
| 6,000 tons Shirebrook 1½-in. nutty slack | 29s. per ton | E. Foster & Co. |
| 2,400 ,, Snibston 1½-in. ,, ,, | 28s. 5d. ,, | |
| 5,200 ,, Bolsover ,, ,, ,, | 29s. 1d. ,, | |

## FORTHCOMING EVENTS.

**British Scientific Products Exhibition, Central Hall, Westminster.**—Thursday, July 3rd, to Friday, August 5th.

**National Foremen's Association, Engineering, Shipbuilding and Allied Trades (West London Branch).**—Friday, July 4th. At 7.30 p.m. At the Norfolk Arms, Burwood Place, Edgware Road. Special meeting.

Saturday, July 12th. At 6.30 p.m. Ordinary meeting.

**Chief Technical Assistants' Association.**—Thursday, July 10th. At 7 p.m. At Anderton's Hotel, Fleet Street, E.C. Paper on "Modernisation of Street Lighting," by Messrs. Young & Ingram.

## NOTES.

**The "Electrical Review" Index.**—As it is still necessary to effect every possible economy in paper consumption, the Index to Vol. LXXXIV of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding or other purposes is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C. 4.

**Technical Inventions in Hungary.**—In Hungary a Decree has been issued ordering all technical inventions belonging to factory owners and all trade secrets to be disclosed to the Soviet for the use of the State. Inventors will receive suitable rewards.—*Times.*

**Anti-Gas Fans.**—At the Royal Society's Conversazione last week, Mrs. Ayrton, M.I.E.E., showed the fans or beaters which she devised for repelling gas attacks and clearing trenches and dug-outs. The action of the fans depends upon the vortex rings which are formed as the fans are brought down flat on the ground. With two of these fans smoke could be driven away at a distance of 60 ft. Large numbers of the fans were used in the war.

**Engineering Education for ex-Service Students.**—A circular has been issued by the Board of Education in regard to the higher education of ex-service students at institutions of lower than University standard. In accordance with the suggestions, Birmingham Education Committee is arranging to provide in the main departments of the Municipal Technical School full-time day courses in metallurgy, engineering, and electrical engineering. The fee payable has been fixed at £20 per session, and while the courses will be open to ordinary students, in the case of approved ex-service students, the fee will be paid by the Board of Education.

**Electric Power Supply During the Great War.**—Under this title, in the current issue of the *Journal* of the Institution of Electrical Engineers, Messrs. Arnold B. Gridley and Arnold H. Human give an account of the work done by the public service electricity supply undertakings and the electrical manufacturing firms of the country, and of the War policy of some of the Government departments associated with the direction of the industry. The review covers the development of electric power supply, of which some particulars have already been published in the ELECTRICAL REVIEW, and explains the functions of the electric power supply department of the Ministry of Munitions, the necessity of control, the attitude of the Government towards electrical development in the country generally, and the value of the services rendered by the supply undertakings. A cordial tribute of praise is paid to the staffs of the undertakings, which maintained the supply throughout the war practically without interruption, in the face of abnormal difficulties and constant overwork. "When all these circumstances are taken into account, it is not easy to express adequately the value of the services rendered by electrical engineers. The four years of war saw practically a development of electrical output equivalent to that of the previous 32 years. This record of increased output for which they have been responsible can perhaps be allowed to stand as the most fitting testimony of their great war achievement. They have well merited and earned the gratitude of the nation and of every department of the Ministry of Munitions concerned with the production of munitions of war."

**Institution and Lecture Notes.—Royal Society of Arts.**—The Council has awarded the Society's silver medal for the following papers (amongst others) read before this Society during the past session:—Mr. Edward C. de Segundo, A.M.Inst.C.E., "The Removal of the Residual Fibres from Cotton Seed, and their Value for Non-textile Purposes"; Sir Frank Heath, K.C.B., Secretary, Department of Scientific and Industrial Research, "The Government and the Organisation of Scientific Research"; Mr. Walter Leonard Lorkin, A.M.I.E.E., "Electric Welding and its Applications"; Prof. J. C. McLennan, O.B.E., F.R.S., "Science and Industry in Canada."

**Illuminating Engineering Society (U.S.A.).**—The 1919 Convention of this Society will be held at Chicago on October 20th to 23rd inclusive.

**Imperial Institute of Patentees.**—*The Times* states that a new Association is being formed by patent owners and manufacturers, with the object of protecting their interests. The Association will probably be known as the Imperial Institute of Patentees (Inc.), a licence from the Board of Trade having been applied for. A preliminary meeting will take place in the Pillar Hall, Cannon Street Hotel, on July 10th.

Mr. Godfrey Chessman, the general secretary of the National Union of Manufacturers, has been asked to act as organising secretary to the new Association. Temporary offices have been secured at 6, Holborn Viaduct, London, E.C. 4, and all interested in patents and desiring to attend the meeting should apply for tickets and other information.

**Appointments Vacant.**—Junior assistant for cable laying, &c., for the Hackney B.C. Electricity Department; charge engineer (70s. + 20 per cent. + £90), for the Croydon B.C. Electricity Department; chief assistant electrical engineer (£220), for the Horsham U.D.C. Electricity Department; principal lecturer in electrical engineering (£150 to £240 + £39), for the Goldsmith College. See our advertisement pages to-day.

**Terrestrial Magnetism.**—According to the report of the Astronomer-Royal, the mean values of the magnetic elements for 1918 and three previous years are as follows:—

| | Dec. W. | Horizontal force. | Vertical force. | Dip. |
|---|---|---|---|---|
| 1915 ... | 14° 56·5′ | 0·18508 | 0·43315 | 66° 51·8′ |
| 1916 ... | 14° 46·9′ | 0·18494 | 0·43313 | 66° 52·7′ |
| 1917 ... | 14° 37·0′ | 0·18477 | 0·43305 | 66° 53·6′ |
| 1918 ... | 14° 27·2′ | 0·18462 | 0·43290 | 66° 54·2′ |

The annual diminution of declination increased considerably about 1910, its average value from 1900 to 1910 being 4·9′. The horizontal force, which had been increasing since measurements were begun at Greenwich in 1846, reached a maximum about 1910, and is now diminishing. The dip, which had been diminishing since measurements were begun in 1843, reached a minimum about 1913, and is now increasing.—*Nature.*

**Illuminations in New York City.**—The "jewelled portal" here illustrated was designed for the reception of U.S. troops in New York, in the illuminating engineering laboratory of the General Electric Co. at Schenectady, under the direction of Mr. W. D'Arcy Ryan. The arch is a gigantic curtain of jewels draped between two obelisk forms: these rise to a total height of

80 ft., and are surmounted by great jewelled forms in the shape of sunbursts 12 ft. wide and 20 ft high. About 30,000 jewels from the famous Tower of Jewels of the Panama-Pacific International Exposition are used in the gigantic curtain, and beams of light from arc projectors are thrown on the arch, causing the thousands of jewels to flash the pure and brilliant colours of the spectrum. The effect is said to be gorgeous. For the photograph we are indebted to the Society for Electrical Development per the Electrical Development Association.

**Electricity for Peace Illuminations.**—The Coal Controller has issued the following notification:—

"It is desired to permit illuminations on this occasion, and as the use of gas and electricity for illuminating purposes will affect the quantity of gas and electricity consumed by persons who are restricted to a definite allowance under the terms of the Household Fuel and Lighting Order, 1918 (or under the new Order when it comes into effect), it is to be understood that no action will be taken in respect of excess consumptions up to 10 per cent. of the allowance for the quarter where a consumer has used gas or electricity for the purpose of Peace illumination.

"If the concession of 10 per cent. is thought to be inadequate by any consumer, the consumer must come to a special arrangement with the Local Fuel Overseer, who will afford every reasonable facility for illuminations on the occasion of Peace.

"This concession relates *only* to illuminations for the Peace, and is not to be made use of for the purpose of taking gas or electricity for illuminated advertisements."

**Electrical Illuminations for the Peace Celebrations.**—The question of providing electric lamps and material for illuminating public and private buildings on the occasion of the Peace Celebrations has been considered at a meeting representative of the manufacturers and electrical contractors chiefly concerned in the work, called by the Electrical Development Association. The Director, Mr. J. W. Beauchamp, informs us that it is feared that delay at the present time followed by a rush of orders toward the end of the month may result in disappointment. It is most desirable that the public should place their orders or inquiries for decorative electrical work *at once*. The busy condition of the industry and shortage of labour in factories and on the staffs of wiring and contracting firms make it most essential that plans for illumination work should be arranged well in advance.

The Electricity Supply Works require early advice of the increase in their load which may be anticipated at the time of the official celebrations, and of any special cable work required.

Persons who may intend to illuminate their premises with decorative material left in hand from previous occasions are recommended to have it examined without delay, as repair and replacement is likely to become more difficult as the time for use approaches.

It is suggested that *electric lamps* in particular should be ordered early, as the great war demands have depleted stocks of the varieties mostly employed for this class of work.

The whole situation has, of course, been immensely changed by the decision of the Government, announced on Wednesday, to set apart one day (Saturday, July 19th) for the Peace Celebrations. Whether this will take the place of the four days at the beginning of August originally indicated is not clear. The time at command for carrying out preparations for the official Peace Day is thus shortened by nearly one-half, and this will further tend to restrict the illuminations to a comparatively unimportant display, though some noted houses will no doubt light them for several days. Attention is drawn to the note which precedes this one.

A considerable amount of strip and wiring material has been manufactured for stock, but further production of this will not be carried on, and those who place their orders first will have the best chance of getting a supply. Neither the wiring contractors nor the supply authorities appear to be at all anxious to encourage decorative lighting at present.

**Sun-spots as Electric Vortices.**—Adopting the hypothesis that sun-spots are vortices in which electrified particles produced by ionisation in the solar atmosphere are whirled at high velocity and thereby give rise to magnetic fields, Prof. Hale has built up a research in which he determines the polarity of the field or direction of rotation of the vortex by observation of the Zeeman effect in the spectrum of the spot. According to *Nature*, in the early stages of this research, before the minimum of 1912, it was found that in the case of groups which consist mainly of two large spots these components were of opposite polarity, and that, in general, the polarities of the leading spots, and consequently the following spots, were of opposite sign in the northern and southern hemispheres of the sun. After the minimum the surprising fact emerged that the polarities were reversed in both hemispheres—that is to say, the preceding spots of northern bi-polar groups which before the minimum were of the same polarity as the north magnetic pole of the earth were of the opposite polarity after the minimum. This state of things endured, and the interesting question arose whether a similar reversal would occur at or near the sun-spot maximum, but in Prof. Hale's report for 1918 it is stated that no general change of polarity has been observed since the maximum, which occurred in the latter half of 1917.

**International Electrotechnical Commission.**—The meeting of the Special Committee on the Rating of Electrical Machinery of the International Electrotechnical Commission was held in Paris last month. Delegates were present from the National Committees of Belgium, Canada, Great Britain, Italy, and the United States. The Canadian delegate, Prof. A. Gill, was taken over by aeroplane from London to attend the meeting in Paris. The delegates appointed by the Main Committee of the British Engineering Standards Association, the sectional committee of which is, *ipso facto*, the National Committee of the I.E.C., were the following: Mr. Roger T. Smith, president-elect, I.E.E.; Mr. A. R. Everest and Mr. C. Rodgers, representing the B.E.A.M.A. on the British National Committee.

The delegates were welcomed by the president of the Commission, M. Maurice Leblanc, at a lunch offered by the French Committee. The technical meetings lasted three days, and a number of important points were discussed. Certain difficulties which had arisen, more especially between the American, British, and French National Committees, due largely to the war conditions, but which had occasioned some feelings of uneasiness on the part of the French Committee, were gone into in detail, and at the conclusion of the meetings, M. Paul Boucherot, who had presided over the meetings, expressed on behalf of his French colleagues his complete satisfaction with the explanations offered. The French Committee entertained the delegates at a banquet at the Hotel d'Orsay, and Dr. C. O. Mailloux and the Americans subsequently offered the delegates a banquet at the Hotel Maurice. The opportunity was taken of the presence of a number of the founders of the I.E.C. to discuss matters of organisation, and also the attitude which should be taken up in regard to the enemy countries. Moreover, in order to honour the founder of the Commission, Colonel R. E. Crompton, C.B., it was proposed that the next plenary meeting of the Commission should be held in London in the middle of October next. This proposal is now before the various National Committees, a number of which have already signified their agreement therewith. It may be expected, therefore, that a very representative meeting of the International Electrotechnical Commission will take place in London towards the end of October next. It is interesting to note that the last meeting of the Commission held in London was in 1908, but since that date the Meetings, of which several have been held annually, except during the war, have all been held abroad, so that this will be an opportunity of giving a very special welcome to prominent electrical engineers from other countries who come to London for this meeting.

## OUR PERSONAL COLUMN.

***The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.***

**Central Station and Tramway Officials.**—Major G. C. MILNES, electrical engineer, Lancaster, has been welcomed back by the Lancaster Corporation on the conclusion of his military duties, which began in 1914.

Mr. RENSHAW, assistant electrical engineer to the Fleetwood U.D.C., is to be paid £146, in pursuance of the award made to electrical power engineers and in consideration of the extra services rendered or to be rendered as acting electrical engineer.

Mr. W. HELLIWELL, centre traffic inspector to the Coventry Corporation electric tramways department for seven years, has been appointed chief inspector to the Hastings Tramway Co., and has taken up his position.

Hull Corporation Tramways Committee, after interviewing seven candidates for the position of general manager of the tramways, has recommended the City Council to appoint Mr. E. S. RAYNOR (electrical engineer and tramways manager of Doncaster) at £800 per annum.

The Aylesbury T.C. has increased the salary of the Electrical Engineer to £360 a year, inclusive of all future work done for the Council.

Halifax T.C. is recommended to increase salaries as follows: Mr. W. ROGERSON, electrical engineer, from £800 to £900; Mr. J. D. CAIRD, tramway traffic manager, from £425 to £475; and Mr. J. W. GALLOWAY, tramway engineer, from £375 to £425.

Mr. W. T. ROBSON, Corporation tramway manager at Southampton, has resigned owing to the condition of his health.

Barnstaple T.C. has voted £20 to the electrical engineer (Mr. HADFIELD) in respect of extra services rendered.

Mr. WM. CHAMBERLAIN, general manager of the Oldham Corporation tramways, was one of the final three selected applicants for the managership of the Hull Corporation tramways. The Oldham Tramways Committee recommends the T.C. to increase Mr. Chamberlain's salary from £450 to £700 per annum, rising by annual increments of £50 to £800 per annum, on the understanding that he undertakes not to terminate his engagement within a period of five years.

Hammersmith B.C. has increased the maximum salary of the Borough Electrical Engineer from £750 by annual increments of £50 to £900, the first increment to be granted at once, plus £20 per cent. war bonus on salary from time to time.

Mr. G. A. PAYNE has resigned his position as chief engineer at Church Stretton (Salop) electricity works, after 15 years' service.

For the position of chief assistant electrical engineer to the Kettering U.D.C. there were 91 applications. Three were chosen for the short list, and from these Mr. C. B. TUTT, engineer in charge, Electricity Works, Manchester, received the appointment.

Mr. C. W. SALT has been appointed borough electrical engineer at Carlisle at £600 a year. Mr. Salt has been electrical engineer at Torquay since 1910, and formerly held appointments at Bradford and Croydon.

Mr. W. BELLAD-ELLIS, municipal electrical engineer of Queenstown, Cape Province, is shortly leaving for England for the purchase of additional plant.

Heston and Isleworth U.D.C. Electricity Committee recommends that Mr. E. W. JAMES, station superintendent, be appointed electrical engineer and manager of the undertaking at £500 per annum, rising by annual increments of £25 to £600.

**General.**—The Rotherham Corporation Tramway Employés' Relief Fund has presented a gold watch to Mr. W. S. MARKS, secretary of the Recreation Club.

Barnsley Education Committee has appointed Mr. J. LAND to conduct classes in electrical engineering for disabled sailors and soldiers at a fee of 4s. per hour.

Mr. WILSON HARTNELL, head of Wilson Hartnell & Co., Ltd., manufacturers of electric light and power plant, Leeds, celebrated his 80th birthday on Friday, when a number of personal and business friends visited his residence at Roundhay and presented him with a handsome silver rose bowl. The names of the subscribers include those of some of the city's leading business men, including three former Lord Mayors and a former Member of Parliament. Sympathetic reference was made to the fact that Mr. and Mrs. Hartnell's only son was killed early in the war.

Major N. H. FIRMIN, Tyne Electrical Engineers, has been restored to the establishment, of which he was a supernumerary whilst employed under the Admiralty for special service. Second Lieutenants J. R. Lang-Hyde, P. F. Fawcett, W. H. Adams, H. Poland and G. Hunter, of the Tyne Electrical Engineers, have been promoted to the rank of lieutenant. Second Lieutenants G. Haigh and J. B. Knowles, London Electrical Engineers, have been given their second "pip" after the qualifying service. Lieutenant Haigh won the Military Medal

whilst serving in the ranks (mentioned in dispatches). Second Lieutenant F. J. Lyon-Davies, Cinque Port Fortress; Second Lieutenant P. Montgomery, Renfrew Fortress R.E.; Second Lieutenant R. Woodland, Lancashire Fortress R.E.; Second Lieutenant A. B. Penney, Hants Fortress R.E.; Second Lieutenant H. W. Knapp, Hants Fortress R.E.; and J. S. Denyer, Kent Royal Fortress R.E., all of electrical light companies, have been promoted to the rank of lieutenant. Captain and Acting Major H. C. Williams, A.M.I.C.E., Lancashire Fortress Engineers (electric lights), has relinquished his acting field rank on ceasing to be employed with the R.E. Captain and Acting Major C. M. Campbell, Tyne Electrical Engineers, has relinquished his acting field rank, reverted to the rank of captain and restored to the establishment of the corps. He was employed in anti-aircraft duties during the war.

Among the passengers on the *Mauretania*, which left for New York on Saturday last, were Sir Wm. Slingo and Miss M. M. Slingo.

On Monday last Mr. A. B. WALKLEY retired from the post of assistant secretary to the General Post Office, on completion of forty-two years in the service.

Mr. A. G. LEONARD, principal clerk in charge of the telegraph branch of the General Post Office, retired on Monday, after nearly forty years' service in the department.

The A.C. Cutting and Welding Co., Ltd., of 25 and 27, Theobald's Road, London, W.C.1, have engaged Mr. W. H. FLOOD as chief engineer to their head office, and he has resigned his appointment as chief electrical engineer with Messrs. William Beardmore & Co. to take up the position. He was previously chief electrical engineer to the late Thames Iron Works Co.

Various changes have taken place in the personnel of the Coal Mines Department. Mr. FRANK PICK, the head of the Household Fuel and Lighting Branch, is obliged, by reason of the increased work devolving upon him in his capacity as commercial manager of the Underground Railways, to relinquish his executive functions, but he has consented, at the Controller's request, to continue to advise upon the administration of the branch. Mr. N. T. FORD, of the Board of Trade, has been appointed to be the executive head of the Household Fuel and Lighting Branch.

Mr. SPENCER HAWES has completed his services with the Admiralty as assistant to the Controller General of Merchant Shipbuilding, and has resumed his practice as consulting engineer with his firm of May & Hawes at Westminster. Mr. Hawes has just been the recipient of a handsome silver cigar and cigarette box from Lord Pirrie, the Controller-General of Merchant Shipbuilding, appropriately inscribed.

Harpin & Co., Ltd., Birmingham, state that Mr. L. J. GELLION, who was a director of the company, has recently resigned his position and severed his connection with the company.

Mr. J. B. BRAITHWAITE has resigned the chairmanship and his seat on the board of the County of London Electric Supply Co., Ltd. Sir Ernest V. Hiley, K.B.E., has been appointed chairman, and Mr. H. B. Renwick (managing director) is now deputy chairman of the company. Mr. J. B. Braithwaite has also resigned the chairmanship and his seat on the board of the South London Electric Supply Corporation, Ltd., and Mr. H. B. Renwick (managing director) has been appointed chairman of the company.

**Roll of Honour.**—The death in action is now announced of Lieut. GEORGE WEBB (25), of the R.A.F. He rose from the ranks, held a commission in the South Staffs, and was transferred in December, 1917, to the R.A.F. Before joining he was an electrician at the Littleton Collieries, Huntington.

**Obituary.**—Prof. E. ERHARD.—The death is announced from Freiberg, Baden, at the age of 80 years, of Professor Dr. E. Erhard, formerly head of the Freiberg Mining Academy. The deceased was well known for his work in connection with the application of electricity to mining operations.

Mr. DAVID A. STARR.—We regret to record the death, which occurred suddenly on June 23rd at Ranfurly Lodge, Bridge of Weir, of Mr. David A. Starr, general manager of the Clyde Valley Electrical Power Co. Mr. Starr had been in failing health for the past eighteen months, and indeed had just recently returned from a four months' trip to the States, Cuba and Jamaica, whither he had gone to recuperate after a serious illness in the spring of 1918. Mr. Starr was a well-known figure in the electrical power supply business in this country, as well as in the States and Canada. He was Canadian by birth, being born in Halifax, N.S., about 61 years ago. His earlier years were devoted to civil engineering, he being for some time on the engineering staff of the Canadian Pacific Railway. Subsequently he joined the staff of the British Thomson-Houston Co., returning later to Canada as general sales manager of the Royal Electric Co., Montreal. In 1901 he came to England as engineer with the British Westinghouse Co., Trafford Park, and in 1903 was appointed engineer and manager to the Clyde Valley Electrical Power Co., then just formed. Mr. Starr was a past president of the Scottish section of the Institution of Electrical Engineers, and he has for many years been closely identified with the work of the Electrical Power Companies' Association.

Lord RAYLEIGH, O.M.—We regret to record the death, which occurred on Monday at the age of 76 years, of Lord Rayleigh, the distinguished physicist, upon whom many degrees and other honours were conferred. President of the British Association meeting at Montreal in 1884; secretary and subsequently president of the Royal Society; Professor of Natural Philosophy at the Royal Institution; discoverer of argon; member of the Board of Trade Committee of Standards of Electrical Measurement; chairman of the Treasury Committee which recommended the establishment of the National Physical Laboratory—the mere mention of these offices will serve to indicate the great influence that he was able to exercise upon the scientific world during a long and pre-eminent career.

Sir JOHN T. BRUNNER.—The death occurred on Tuesday morning at Chertsey, from heart failure, of Sir John Brunner, founder with Dr. Ludwig Mond, the celebrated chemist, of the business of Brunner, Mond & Co. He was 77 years of age.

Mr. W. M. MURPHY.—The death has occurred, in his 75th year, of Mr. W. Martin Murphy, J.P., chairman of the Dublin United (Electric) Tramways Co., who did pioneering work in connection with numerous railway and tramway systems and industrial enterprises. Mr. Murphy was a native of Bantry, Co. Cork, and started life as a building contractor in succession to his father. He was one of the pioneers in the construction of light railways and tramways. In Ireland he was responsible for various railways, and in regard to tramways he was prominently interested in the Belfast and Dublin systems, Cork Electric Tramways & Lighting Co., Isle of Thanet Electric Tramways & Lighting Co., Hastings & District, Bournemouth & Poole, and Paisley & District. It was as the result of a visit to America in 1895 that he became alive to the possibilities of electric traction, and on his return he promptly proposed its adoption in Dublin on the overhead trolley system. Mr. Murphy had many and large interests beyond these, including a big drapery store, the *Irish Independent* newspaper, several leading hotels, &c. An outstanding event in Mr. Murphy's career was his plucky stand against the forces of syndicalism organised by James Larkin in Dublin in 1913. The strikes that brought such misery in their train originated with the tramway men, but for those who went out other men were put on the cars within half an hour, and traffic proceeded as usual. During the strike period Mr. Murphy stood firm, and won through in the end, the disturbers of industrial harmony being utterly routed.

**Will.**—The late Alderman JAMES HEALD, of Lancaster, of the firm of Calvert & Heald, electrical engineers, Lancaster, and chairman of the Lancaster Electricity Committee, left estate valued at £45,451.

## NEW COMPANIES REGISTERED.

**Eclipse Cycle Co., Ltd.** (156,252).—Private company. Registered June 20th. Capital, £2,000 in £1 shares. To acquire the business of cycle and gramophone dealers carried on by A. Jones and J. Williams at 45, Old Chester Road, Tranmere, Birkenhead, 2, Church Road, Tranmere, and 326, New Chester Road, Rock Ferry, under the style of "The Eclipse Cycle Co.," and also the business of electrical and motor engineers at 10, Church Road, under the style of the "Eclipse Electrical and Motor Engineering Co." The subscribers are: A. Jones, 15, Cressington Avenue, Birkenhead, cycle and gramophone dealer, 1,266 shares; J. Williams, 17, Cressington Avenue, Birkenhead, cycle and gramophone dealer and builder, 634 shares. Directors: A. Jones and J. Williams. Solicitor: J. Roberts, 8, Duncan Street, Birkenhead. Registered Office: 10, Church Road, Tranmere, Birkenhead.

**South of Scotland Electrical & Mechanical Engineering Co., Ltd.** (10,462).—Private company. Registered in Edinburgh June 14th. Capital, £5,000 in £1 shares. Engineers, electricians, makers and repairers of and dealers in and hirers of aeronautical engines, motors, accumulators, motor cars, cycles, launches, vessels and aeroplanes, &c. The subscribers (each with one share) are: H. J. Berry, Cliffe Villa, Shepley, Huddersfield, electrical engineer; E. Moodycliffe, 43, Barcroft Road, Close Hill, Newsome, Huddersfield, electrical engineer; S. W. Marshall, 2, Camden Place, Dumfries, mechanical engineer. First directors: H. J. Berry, Edgar Moodycliffe, Samuel W. Marshall, James Clarke McGeorge, jun., hosiery manufacturer, Dumfries, and A. G. McGeorge, hosiery manufacturer, Dumfries. Solicitor: D. Stoba, 93, Irish Street, Dumfries.

**T. Beadle & Co., Ltd.** (156,275).—Private company. Registered June 20th. Capital, £20,000 in £1 shares. To take over the business of factors and dealers in electrical supplies, motor car and cycle accessories and tools carried on at Hull by T. Beadle & Co. The subscribers (each with one share) are: T. Beadle, 75, Victoria Avenue, Hull, electrical factor; G. H. Atkinson, 107, Linnaeus Street, Anlaby Road, Hull, electrical factor's manager. Directors: T. Beadle, G. H. Atkinson and R. L. Hought, 79, Finkle Street, Cottingham, commercial traveller. Solicitor: G. T. Mainprize, Temple Buildings, Bowlalley Lane, Hull. Registered office: 3, Castle Street, Hull.

**Tungsten Manufacturing Co., Ltd.** (156,321).—Private company. Registered June 21st. Capital, £150,000 in £1 shares. To enter into an agreement with W. L. T. Wright, and to carry on the business of manufacturers of tungsten and other metals, and articles made therefrom, electrical and mechanical engineers, &c. The subscribers are: E. N. G. Arkell, Kensington Court Hotel, 30, Pembridge Square, W., solicitor; G. Wooden, 10, New Square, Lincoln's Inn, W.C., solicitor's managing clerk. The subscribers are to appoint the first directors. Qualification, £100. Remuneration (except managing director), £150 each per annum, with £50 extra for the chairman, and a share in the profits. Solicitor: A. G. Craig, 10, New Square, Lincoln's Inn, W.C. Registered office: Thanet House, Strand, W.C.

**Ellesco, Ltd.** (156,339).—Private company. Registered June 23rd. Capital, £2,000 in £1 shares. Objects: To carry on the business of electrical, mechanical, aeronautical, dairy, printers', bookbinders' and stationers' engineers, cutter and spring manufacturers and contractors, &c., and to adopt an agreement with J. Lee, of Albion Engineering Works, 81, Rosebery Avenue, London. The subscribers (each with one share) are: W. Ellerd-Styles, 91, Forest Drive West, E., electrical engineer; J. Lee, 47, Cow Cross Street, E.C.1, engineer; W. R. Catton, 101, Park Lane, N.16, engineer. The first directors are: J. Lee and W. Ellerd-Styles. Solicitors: Bishops & Fenton-Jones, 76, Kingsland High Street, N.E. Registered office: 81, Rosebery Avenue, N.6.

**Impervious Fittings, Ltd.** (156,308).—Private company. Registered June 21st. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers of electric fittings and apparatus, other than cables, &c. The subscribers (each with one share) are: G. H. Scholes, Meadow Cottage, Dean Row, Wilmslow, electrical engineer; E. A. Claremont, High Legh, Cheshire, engineer. Permanent directors: G. H. Scholes and E. A. Claremont. Solicitors: Claremont, Haynes & Co., Vernon House, Bloomsbury Square, W.C.

**Hatcham Manufacturing Co., Ltd.** (156,393).—Private company. Registered June 24th. Capital, £3,000 in £1 shares. To take over the business of electrical and general engineers carried on by A. S. King, E. A. Endacott and F. W. Carpenter, &c. The first directors are: A. S. King, Havant House, Seymour Road, Hampton Wick; E. A. Endacott, 58, King Edward's Gardens, Acton Hill, W.; F. W. Carpenter, 20, Blandford Road, Bedford Park, W.4 (all metal dealers). Solicitor: A. Lloyd-Jones, 40, Broadway, Ealing, W. Secretary: F. W. Carpenter. Registered office: 314, Gray's Inn Road, W.C.

**Abbott Turner & Co., Ltd.** (156,401).—Private company. Registered June 25th. Capital, £500 in £1 shares. To enter into an agreement with Turner & Co., of 261b, New John Street West, Birmingham, electrical engineers, and to carry on the business of electrical, gas, sanitary, water and mechanical engineers, &c. The subscribers (each with one share) are: C. C. Turner, 125, Osborne Road, Sparkhill, electrician; V. Smith, Primrose Cottage, Hampton in Arden, clerk. First directors to be appointed by the subscribers. Registered office: 6, Temple Row, Birmingham.

## CITY NOTES.

**United River Plate Telephone Co., Ltd.**

Sir Frederick Green, presiding at the annual meeting on June 24th, referred to the satisfactory position of the company in spite of difficulties due to shortage of materials owing to the war. For four or five years they had been largely depending upon spare plant bought previous to 1914, but this became practically exhausted about the middle of 1918, and since then they had only been able to connect new subscribers in Buenos Aires as lines became vacant. It would not be possible to give much relief, at least in the centre of the city, before the end of next year, as switchboards took a considerable time to manufacture and buildings to accommodate them to erect. The earnings in Argentina and London increased by 14 per cent.; maintenance and other expenses of management by 16 per cent. The working expenses had increased in a greater ratio than the earnings, as the cost of living had risen, and wages and salaries had to be increased; materials had also cost more. The amount to the credit of the reserve for renewal of plant was greater than it should be through their inability during the war to undertake much renewal work. As soon as the necessary stores could be obtained they had considerable leeway to make up, entailing much heavy expenditure. Those works would take time, although the procuring of material was becoming easier. In regard to the work carried out during the year they had increased their subscribers' stations by some 6,200, mostly during the first six months of the year. They had a long waiting list. They now had a total of 72,005 throughout the system as against 65,788 last year. Except in the Province of Cordoba they had not been able to open many new exchanges, but in that particular district, which was at present isolated from the main system, they had increased the number by nine to 32. In the Federal capital they had laid down a good deal of underground work in congested areas, as they were fortunate enough to have a large stock of conduits, but they had not yet been able to bring into service the new common battery exchange at Belgrano, the equipment for which was ordered in 1916. In the suburbs of Buenos Aires they had been able to carry out some of the much-needed reconstruction work, and also to provide a number of additional junction circuits, but they had been prevented from completing the whole of the works. For some time past the labour position in Buenos Aires had not been satisfactory. There were riots and street fighting, but when practically all other means of communication had ceased, they were able, with the protection afforded by the Government, to continue the telephone service almost as if conditions were normal. In March their own employés came out on strike, but they were able, with the assistance of 200 loyal operators and the engineering staff, to give a limited service. The President of the Republic intervened, and the strike ended in 15 days. One of the things that the strikers insisted on was the winding up of the staff provident fund, to which the company had contributed £2,000 per annum for very many years. There was now, therefore, no necessity to make a further donation to that fund. The cost of the concessions that they had made would probably amount to not far short of £100,000 per annum. The Government had promised to give favourable consideration to a reasonable increase in rates to meet that expenditure, and negotiations were now in progress. This would not, however, be the whole of the new burdens which the company would have to bear, as there was now before the Senate a Bill, which had been passed by the Chamber of Deputies, for the purpose of establishing a State pension fund for the employés of the tramways, telephone, gas and electric lighting companies, to which fund it was proposed the companies concerned should contribute 8 per cent. of the wages and salaries paid. The company's capital outlay per subscriber would also be heavier in the future, due to the advance in cost of telephone material. As to the results for the current year, they had hopes that they would be at least as satisfactory as those now under review, but until they were able to provide switchboard and cable plant they could not look for much increase, but he hoped they need not expect any falling off, provided they were allowed to increase their rates. The prospects of Argentina appeared to be good. The harvest of the late summer was quite an average one, but the unfortunate port strike, which had been in existence since January last, had considerably reduced shipments to Europe. It had also been a serious strain on the available tonnage of the world, as for many weeks over 100 steamers were lying idle in the roads waiting to discharge. Fortunately to-day the outlook was decidedly brighter. The speaker went on to refer to the excellent services of the local committee; the manager, Mr. Barber; the assistant managers; the engineer-in-chief (now on a visit here); and others.

**Callender's Cable and Construction Co., Ltd.**

The report for 1918 shows a balance at credit of profit and loss of £134,969. Debenture interest absorbs £13,500; preference dividend £11,643; depreciation of buildings, plant, and machinery, £37,000; depreciation of office furniture, £264; leaving £72,561, plus £111,509 brought forward. Dividend on 70,000 ordinary shares, 12½ per cent. per annum, less tax, £43,750; dividend at 12½ per cent. per annum, less tax, from date of allotment and final instalment on 10,000 ordinary shares (1918 issue), £542; to reserve, £25,000; carrying forward, subject to excess profits duty, if any, £114,779. Until the signature of the armistice only materials required for war service were produced by the company, and, until that date, output again increased considerably. After the cessation of hostilities such manufactures ceased, and before the end of the year the break clause had been put generally into operation on all Government contracts. As heavy engagements had been undertaken for the execution of these contracts, much time had to be given to their adjustment and to the re-arrangement of the factories for ordinary business. This transition period continued into the present year, and was a time of much anxiety to the management, and of impaired efficiency in the workshops. In order to meet the requirements of the Admiralty, the War Office, and the Ministry of Munitions, large extensions were made at Erith during the last two years (and in the Leigh factory of the Anchor Cable Co.), for the production of cables and other materials necessary for carrying on the war. This plant and machinery is now being adapted, so far as possible, for commercial production. Under an agreement with the Government an entirely new factory was erected at Picardy, close to the Erith works, in which large quantities of field telephone cable for Army use have been produced. These being no longer required, arrangements are in progress for the conversion of the Picardy works to ordinary manufacturing. Much assistance was thus rendered to the country, and the directors received official letters of thanks from the Admiralty, the Ministry of Munitions, and other Government Departments, for the way in which contracts entrusted to this company were executed. Difficulties of transport and in the supply of raw materials, and the increase in wages, with the reduction of working hours, made under Government awards, have rendered profitable commercial production exceedingly difficult. Ordinary manufacture for commercial use has now re-started, and the company has secured important contracts for power, telephone, and other cables at home and abroad, the works being thus fully engaged. All plant and appliances have been maintained in efficient working condition, but, owing to the heavy cost of upkeep, a much larger sum has this year been expended in maintenance than in the past. The business of the Anchor Cable Co., Ltd., has again given satisfactory results. The rearrangement of the capital by the issue of fully-paid shares to existing holders of ordinary shares was duly completed during the year. In the latter part of 1918 it became evident that further capital was necessary to enable the company properly to carry out its commercial operations, and with the authority of the shareholders 40,000 new preference shares and 10,000 new ordinary shares were issued. The issue, made a few days before the armistice, was largely over-subscribed.

Accompanying the report there is issued a Roll of Honour showing that 817 men joined the Forces, and of these 66 gave their lives for their country.

**United Electric Tramways of Monte Video, Ltd.**

Sir G. A. Touche presided at the annual meeting, on June 25th. The pleasing feature of the year's operations was the continued increase in the traffic receipts. The gross receipts constituted a record; they were £20,467 more than in the previous year, and £6,774 more than in the highest pre-war year. The advance was in spite of the fact that their employés were involved in the two-months' general strike in Monte Video in August and September, 1918. The number of passengers carried also constituted a record, beating the pre-war record by nearly 7½ per cent. Expenses continued to increase. They were £31,756 more for 1918 than for 1917. More than 80 per cent. of the increase was due to cost of fuel, which averaged 146s. per ton, against 104s. 7d. in 1917, an increase of 41s. 5d. per ton, or more than the entire pre-war cost. The increase on 13,179 tons was thus £27,399. For the five months ended March the average cost was 141s. 6d. per ton; it was now round about 100s. The balance of the increase in expenses was due to higher cost of all maintenance materials, and to the increase in wages, which was in operation during the last two months of the year. The net

receipts of the Uruguayan Co. fell by £11,289. Their claim for introducing a revision of tariffs was a very strong one, but up to the present the authorities had in no way assisted the company to meet the increasing burden of expenses and improve the lot of its employés. The directors recommended the payment of a dividend on the cumulative preference shares, less income tax, in satisfaction of the arrears for the half-year to September 30th, 1917, and with improving conditions it was hoped to make increasing payments on account of arrears, and ultimately to resume the regular payment of current dividends. The chief reason for recommending this payment on account was found in the better prospects indicated by the experience of the current year. The directors entered into negotiations some time ago for a sale of the tramway undertaking to the Government. Terms were provisionally agreed, but no binding contract had been entered into.

**Anglo-Argentine Tramways Co., Ltd.**

The gross receipts for 1918 were £3,012,821, less working expenses £2,375,564, leaving £637,257, plus interest on investments, &c., £43,020, and £67,990 brought forward, making £748,268. From this there are deducted: Annuity to City of Buenos Ayres Tramway Co. (1904), Ltd., £70,660; debenture interest and sinking fund £587,821; preference and ordinary share redemption sinking fund £6,744. The balance of net revenue to be carried forward to 1919 is £83,043. Having regard to the abnormal cost of fuel and the uncertainty of the outlook, owing to the present unstable conditions in Buenos Ayres, the labour unrest, and the pending demands for shorter hours of service, the directors are not yet justified in recommending the payment of any dividend on the preference shares. The traffic receipts for 1918 were £2,909,376, an increase of £209,132; passengers carried, 349,286,338, against 324,231,620. The most stringent economies have been exercised, but many of the expenses are entirely beyond the company's control, and are owing chiefly to the freight situation, which, however, has become better during the current year. The abnormal cost of fuel is alone responsible for an additional expenditure of £245,959 for electric energy, as compared with 1917. The cost of all materials for maintenance remains high. Mr. William Morris, of Messrs. Ashurst, Morris, Crisp & Co., has been elected to the board. The directors' report is accompanied by a lengthy report by the general manager, Mr. G. Pedriali. He shows that the country has gone ahead and business in general is reviving in a very marked form. The population of the city increased by 15,323 during 1918. Tramway traffic revived very considerably as a consequence of the improvement in business generally. In the course of the technical details, Mr. Pedriali shows that no coal was received during 1918, and comparatively little petroleum had been burned. Fuel had been confined mostly to hardwood, maize, and other grains, the result being disastrous. As to the prospects: "The increased traffic movement has brought more passengers, and consequently our receipts per car mile are increasing, and if the price of current can be brought down again considerably, our profits will begin to revive during this year. Nevertheless, the state of the labour world is menacing, and may have a very prejudicial effect. It is doubtful if we shall be able to keep up our present rate of increase in traffic which is now well over 12 per cent., as compared with last year, and I think that, if we can, by the close of the year, show an increase of 5 per cent. we may consider ourselves lucky under the circumstances." Miles run 53,118,576, against 52,456,535 in 1917. Receipts per mile run 13.61d., against 12.73d. in 1917. Expenses per mile run, exclusive of paving or renewals expenditure 10.31d., against 8.97d. in 1917. Cars in stock 2,715, against 2,746 in 1917.

**The General Electric Co., Ltd.**

The report for the year ended March 31st, 1919, states that the net profits were £480,828, plus £145,286 brought forward, less £70,000 payment on account of excess profits duty, making a total of £556,114. From this the following are deducted: Debenture interest, £8,000; normal and special depreciation, £73,653; grants to dependants of men on active service, £16,790; 6½ per cent. preference dividend, £85,292; to reserve, £117,000. After paying 10 per cent., free of tax, on the ordinary shares, £141,502 remains to be carried forward, subject to excess profits duty. The directors express themselves satisfied with the results of the year's trading, more especially as the period under review has witnessed the partial change-over from war work to peace work, on which the company has been mainly employed since the cessation of hostilities. The directors appreciate the loyalty and assistance rendered by the employés during this strenuous period. Approximately 750 of the company's employés have been demobilised. The promise of reinstatement has been faithfully kept, without inflicting any appreciable hardship on those who filled their places during the war. The figures of the balance sheet do not lend themselves to comparison with the figures of previous years, owing to the carrying through of certain important operations, which were foreshadowed at the last annual meeting. During the year the company acquired the engineering works of Fraser & Chalmers, Ltd., and this concern, as well as the Osram-Robertson Lamp Works, Ltd., has been entirely absorbed into the G.E.C. organisation. This absorption mainly accounts for the very considerable additions to the items freehold land and buildings and fixed plant and machinery. The investment account has naturally been reduced; as what was formerly an investment in shares of the Osram Co. is now represented by the actual assets of that company. Sundry debtors and stock-in-trade are much increased compared with previous years. The increases are partly due to the inclusion of the sundry debtors and stock-in-trade of Fraser & Chalmers and the Osram Lamp Works, but they are also a reflection of the larger operations of the company toward which the acquisition of these works has materially contributed. The directors are satisfied that both items are valued on the company's usual conservative basis.

The directors report that the large increase of capital, effected early in the year, is already justified by results. They have decided upon their post-war programme, a brief outline of which will be presented at the annual meeting. To give effect to this policy will require a further increase in capital, and it is proposed to ask the shareholders for authority to increase the capital to six million pounds, but they do not propose to make an issue forthwith, but only as and when they are of opinion that the necessities of the business require it. Resolutions to give effect to the increase of capital and for splitting the existing £10 preference and ordinary shares into £1 shares will be submitted to an extraordinary general meeting to be held immediately after the annual meeting on Wednesday, July 9th.

All the works of the company are at present fully employed, and building operations are already in progress to provide additional accommodation for works urgently required which, but for the war, would have been long since erected. The Government have now vacated the company's building in Kingsway, and the contract for the completion of the building has already been placed. It is hoped that it will be ready for occupation in 1920. The allied and subsidiary enterprises of the company have again shown satisfactory results.

The sum of £37,500, granted out of the company's reserves at the last annual general meeting for the superannuation, pensioning off, and benefit of the company's employés, in accordance with the terms of the trust, has been invested in 3,750 ordinary shares of the company at par. In administering this fund the directors propose to be guided by the report of a special committee appointed to deal with the whole question, in accordance with which they will primarily consider those employés who had completed 15 years' service on December 31st, 1918. The directors also propose to establish a contributory pension scheme for the benefit of all employés.

Sir John P. Hewett, G.C.S.I., Mr. James Fraser, and Mr. C. Wilson, who were formerly members of the Osram board of directors, have now joined the board of this company.

**Rangoon Electric Tramway and Supply Co., Ltd.**

Sir F. W. R. Fryer presided at the annual meeting on June 25th. He said that the power house expenses were £66,723, against £61,546 for 1917. Fuel increased by £4,319 due to the adoption of paddy husk as a substitute for coal. They were still, owing to the shortage of supply of paddy husk, consuming several other vegetable substances, and though paddy husk had been successfully used as fuel for many years in Burma, there were still some disadvantages attending its use which had to be overcome. The capital cost of alterations involved in the adoption of paddy husk as fuel had been considerable, but would not, of course, recur. The improvement in the tramway service returns continued to show most healthy expansion. The cars carried 34.75 per cent. more passengers than in 1917. Arrangements were in hand for considerable extensions of the tramways system as the necessary materials became available. The lighting and power returns continued to show healthy increase which had only been limited by the want of additional machinery which was now ready for dispatch to Burma. The revised public lighting agreement for twelve years, providing for considerable extension and improvement, had been signed. Expenses of renewals and repairs would continue to be exceptionally heavy. They had weathered the storm, and tramway and lighting business would continue to increase now that war restrictions had ceased.

**J. G. White & Co., Ltd.**

Mr. G. M. Booth presided at the annual meeting on June 26th. He said that the task of restoring business conditions to a pre-war basis was going to be long and difficult. He failed to see how our trade was to be restored to its proper place unless all classes recognised that the war had left us poorer, and that we must all work harder. There was little encouragement in this direction to be found in the speeches of leaders of labour organisations. Squabbling about how profit should be divided was mere midsummer madness to those who felt that in the very near future there would be all too little profit of any sort whatever to divide. Nothing but co-operation between capital and labour would enable us to win through in the uphill task. The business of the year had proved not unsatisfactory, and it was remarkable that they had been able to show some increase in net profits. Ordinary engineering construction had been practically suspended and the profits in this direction were less than 20 per cent. of the whole profit. The balance had come from interest on the company's investments, from their operating contracts with public utility companies, and from special war contracts. As to the future, they were now disposing of surplus engineering stores for the American Government, but this work would soon terminate, and they must now devote their efforts to peace-time activities. They had re

cently been awarded a small tramway reconstruction contract, but conditions for carrying out any new work were extremely difficult. Their investment account should show better results, and their operating department was also in good shape, and as they added additional management contracts to their list, they were able to reduce to some extent the expense ratio and so secure improved profits. An important addition to this section was the operating contract secured with the Chilean Electric Tramway & Light Co. The International Light & Power Co., in which they held a large block of shares, was doing well. Since the armistice the whole of the arrears of preference dividend had been paid off, and the earnings for the current year showed an improvement over those for 1918, which were themselves the best in the history of the company. Their subsidiary company for trading purposes now existed under the name of the J. G. White Commercial Co., Ltd. The results so far had been fairly satisfactory.

**Electric & General Investment Co., Ltd.**—Gross profit for year ended May, 1919, £8,117. After deducting general charges and debenture interest, and adding £17,225 brought forward, the balance is £23,352. The directors hope to be in a position to resume the payment of the half-yearly dividend on the preference shares on January 1st next. As it is impracticable to pay off immediately in cash the arrears on these shares, which at June 30th, 1919, will amount to 30s. on each £5 share, the directors are considering various methods for dealing with same, and they propose to consult representative shareholders before submitting a definite scheme. Mr. S. R. Shaw, the former secretary, suffered so severely in health through Army service that he had to resign his appointment. It is proposed to grant him a retiring allowance in consideration of his prolonged service with the company. Mr. R. L. Sare has been appointed secretary.

**Crompton & Co., Ltd.**—For the year ended March 31st, 1919, the net profit after providing for depreciation, debenture interest, directors' fees, &c., and a reserve estimated to be sufficient to cover excess profits duty, is £38,828, plus £26,030 brought forward. There has been put to general reserve £10,000; 10 per cent. is paid on the preference and 10 per cent. on the ordinary shares; £16,396 is written off expenses in connection with debenture issue, including premium on redemption of old debentures, discount on new issue, and tax on additional share capital. £17,409 remains to carry forward. The directors have had under consideration the question of the new capital required to meet the growth of the company's business, as explained at the general meeting on February 14th last, and a resolution will be submitted to the shareholders at the meeting to-day to confirm a provisional agreement with Sir W. G. Armstrong, Whitworth & Co., Ltd., to subscribe for 250,000 of the unissued £1 ordinary shares of the company at par, two of the directors of Sir W. G. Armstrong, Whitworth & Co., Ltd., joining the board of this company. The board are unanimous in recommending to the shareholders the proposed arrangement with Sir W. G. Armstrong, Whitworth & Co., Ltd., which, in their opinion, is likely to prove of considerable benefit to the company's future interests.

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**Waygood-Otis, Ltd.**—At the annual meeting, held last week, the chairman said that they had reorganised for a return to their pre-war line of business, and were now almost wholly engaged upon lifts and cranes. The change over was not without its difficulties, and involved expense, but these were now practically behind them. Unfortunately they had still to contend with delay in securing raw materials and in the delivery to different parts of the country of their manufactures, due to congestion on the railway systems, but these troubles, inevitable after the dislocation of civil work during the war, would doubtless gradually be removed; they had in the meantime handicapped progress and output. They had rebuilt a portion of the factory and installed many additional up-to-date machine tools; the resulting developments appreciably added to the capacity of their shops. They were aiming at further standardisation, which would permit of mass production and the carrying of a suitable stock of manufactured apparatus to a greater extent than before the war, and by these means and the improved manufacturing facilities they hoped to offset in some measure the higher costs of labour and materials, so that prices might encourage prospective buyers to place their contracts without delay.

**New Issue.**—Last week the Fellows Magneto Co., Ltd., offered for subscription 100,000 8 per cent. cumulative participating preferred shares of £1 each at par and 25,000 ordinary shares of 10s. each at 15s. per share, the capital being required for expansion of the business.

**Aluminium Corporation, Ltd.**—The meeting called for Monday last was merely formal, in order to comply with the Companies Act, and to enable a preference dividend of 7 per cent. for the year, 1918, to be declared. This having been approved the meeting adjourned until the accounts can be submitted.

**Anglo-American Electric Co., Ltd.**—Profit for the year £1,381, plus £19,821 brought forward, making £21,202, which is to be carried forward.

**Edgar Allen & Co., Ltd.**—Final dividend 2s. 6d. per share, making 17½ per cent. for the year, free of tax.

**Companies to be Struck Off.**—The following are to be struck off the register within three months unless cause is shown to the contrary:—

Alpha Electrical Co, Ltd.
East London Electric Co., Ltd.
G.O. Accumulator, Ltd.
Leonard W. Holmes & Partners, Ltd.
Metallurgical and General Industries, Ltd.
Metallurgical Research Co., Ltd.
South American Railless Traction Co., Ltd.

**Adelaide Electric Supply Co., Ltd.**—Mr. J. B. Braithwaite presided on Tuesday over an extraordinary general meeting of the holders of the 6 per cent. cumulative preference shares of the above company, and proposed a resolution increasing the capital of the company from £750,000 to £1,000,000 by the creation of 250,000 "A" preference shares of £1 each. He explained that the company's business was rapidly outgrowing the capacity of the power house at Adelaide, and it had become urgently necessary to build a new one. The lease of a suitable site at Port Adelaide had been acquired from the Harbours Board, and the new capital was required to provide the cost of the new power house and for the extension and development of the business generally. Mr. A. J. Farish seconded the motion, and the resolution was carried. Subsequently an extraordinary general meeting of the company was held, when a similar resolution was agreed to by the ordinary shareholders.

**South Wales Electrical Power Distribution Co.**—The report for 1918 states that the units sold amounted to 36,593,903, a decrease of 365,146 units. After payment of all expenses, the credit balance of the year's working was £26,144. Deducting interest on prior lien debenture stock and the original debenture stock, and making provision for depreciation of the new plant, there remains £52 to be carried forward. —*Financial Times.*

**Chili Telephone Co., Ltd.**—For the year ended March, 1919, there is a profit of £82,149. After deducting income tax and excess profits duty and placing £16,964 to general reserve and £15,000 to reserve for renewal of plant, the directors recommend a final dividend of 3s. per share, free of tax, leaving £8,510 to carry forward.

**Telegraph Construction and Maintenance Co., Ltd.**—Interim dividend of 6s. per share, free of income tax.

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## STOCKS AND SHARES.

Tuesday Evening.

With the Loan campaign intensified, business in Stock Exchange securities is quiet. No kind of boomlet followed the signing of the terms of Peace. There is nothing like the same degree of cheerfulness as prevailed at armistice time. Men's minds are bent too seriously upon the pressing post-war problems for them to rejoice whole-heartedly at the conclusion of a Peace which few believe the former enemy regards as any more binding than, for instance, his previous Treaty with Belgium. But there is a willingness to turn to the future and to hope, if rather quietly, for the best.

London Electric Supply shares are weak on the various memoranda presented to shareholders in connection with the Government Bill. The subject is dealt with more fully elsewhere in this issue. An officer, recently demobilised and returned to the Stock Exchange market, declared colloquially that the various directors had "properly put the wind up" the investors interested in electric shares. Bromptons are 5s. down, so are City of London. Kensingtons, St. James's and Metropolitans have all lost 2s. 6d. Westminsters had experienced a sharp drop in the previous fortnight, and this brought in a few bold buyers, whose purchases rallied the price to 5¼, while County of London Ordinary were taken at 9 11-16, the price mentioned here last week, and have recovered to their par value of 10. It is difficult to avoid the impression that shareholders are giving way to scare, although if the Bill is as wicked and malevolent as its opponents aver, the outlook for the London companies must be distinctly bad. It may be suggested, however, that perhaps the opposition is making the utmost of the case against the Bill.

Manufacturing shares are inclined to be somewhat dull in sympathy with the depression in the market for London lighting shares. English Electrics have given way to 27s., and the rest of the group is none too good. The General Electric Company's report makes pleasant reading. Since the last accounts were published the Osram-Robertson Lamp Works Company has been absorbed and part of the Fraser and Chalmers business taken over, so that exact comparison cannot be made with the previous figures. But the net profit of £382,400 is £133,000 better, and substantial increases are made to the appropriations. The dividend is maintained at 10 per cent., free of tax. It is proposed to take steps to double the capital and to make it six million pounds. No doubt in the process the shareholders will get that slice of melon for which they have been diligently prepared by various references in this column in April and May last, when broad hints were thrown out as to what was likely to happen, and when the price of the ordinary stood several pounds per share lower than it does to-day.

(The financial commentator hears only, as a rule, of those cases in which any following of his suggestion is fraught with unpleasant consequences to the investor.)

Callender's Cable shares have come down owing to disappointment at the dividend not being increased. Last year it was 25 per cent., and, the capital having been doubled in the meantime, it is now 12½ per cent. Net profits of £135,000 are £13,000 up on last year's figures. What made holders a trifle shy was the statement in the report to the effect that after the cessation of hostilities and the operation of the Break Clause in Government contracts, much time had to be given to the rearrangement of the factories for ordinary business, resulting in impaired efficiency in the workshops. The same sort of conditions will doubtless operate in numbers of industrial concerns, and the coal, iron and armament shares are dull in tone because of the uncertainty felt in regard to the time it will take for swords to be beaten into ploughshares. Babcock & Wilcox are 1-16 down at 3¾.

Cable stocks continue to display hesitation. Globe preference are ¼ lower, Anglo-American preferred ½, West India and Panama 1-16. Marconis fell away to 6¼ and Marconi Marines to 3 5-16. American Marconis are the firmest of the party at 32s., Canadians keep a shade below 18s., and Spanish are 15s.

Home Railway stocks have reverted to the Slough of Despond, out of which they gave a brief promise of struggling a week or two ago. Underground £10 shares are ½ down and the shilling shares lost ninepence. Metropolitan Consolidated fell ½. Rubber shares show a better disposition upon a slender recovery in the price of the raw material. It is thought that the raising of the blockade, upon ratification of the Peace Treaty, may be followed by large orders from the Central Powers for rubber, as well as other produce.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1917. | Dividend 1918. | Price June 30, 1919. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| **HOME ELECTRICITY COMPANIES** | | | | | |
| Brompton Ordinary | 10 | 8 | 6½ | — ½ | £6 1 6 |
| Charing Cross Ordinary | 4 | 4 | 3 | — | 6 13 4 |
| do. do. 4½ Pref. | 4½ | 4½ | 3½ | — | 6 18 4 |
| Chelsea | 5 | 5 | 3½ | — | 4 12 4 |
| City of London | 8 | 8 | 11½ | — ½ | 6 18 0 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10 | — | 6 0 0 |
| County of London | 7 | 7 | 10 | + ½ | 7 0 0 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10 | — | 6 0 0 |
| Kensington Ordinary | 7 | 6 | 6½ | — ½ | 5 5 0 |
| London Electric | Nil | Nil | 1½ | — | Nil |
| do. do. 6 per cent. Pref. | 6 | 6 | 8½ | — | 7 14 10 |
| Metropolitan | 4 | 6 | 8 | — ½ | 8 6 8 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 8½xd | — | 6 18 6 |
| St. James' and Pall Mall | 9 | 10 | 7 | — ½ | 7 2 0 |
| South London | 5 | 5 | 9½ | — | 7 5 6 |
| South Metropolitan Pref. | 7 | 7 | 20/6 | — | 6 16 7 |
| Westminster Ordinary | 9 | 8 | 5½ | + ½ | 6 19 8 |
| **TELEGRAPHS AND TELEPHONES** | | | | | |
| Anglo-Am. Tel. Pref. | 6 | 6 | 98 | — ½ | 6 2 3 |
| do. Def. | 1½ | 33/6 | 22½ | — | 7 8 0 |
| Chile Telephone | 8 | 8 | 7 | — | 5 14 4 |
| Cuba Sub. Ord. | 7 | 7 | 11 | — | *8 4 5 |
| Eastern Extension | 8 | 8 | 16 | — | *5 0 0 |
| Eastern Tel. Ord. | 8 | 8 | 161½ | — | *4 19 1 |
| Globe Tel. and T. Ord. | 7 | 8 | 16 | — | *5 0 0 |
| do. do. Pref. | 6 | 6 | 10½ | — ½ | 5 14 6 |
| Great Northern Tel. | 22 | 22 | 82 | — | 6 17 6 |
| Indo-European | 13 | 13 | 55 | — | 5 18 2 |
| Marconi | 20 | 20 | 6½ | — ½ | 3 7 6 |
| Oriental Telephone Ord. | 10 | 15 | 2½ | — ½ | 6 13 4 |
| United R. Plate Tel. | 8 | 8 | 7½xd | — | *5 2 0 |
| West India and Panama | 1/3 | 1/3 | 1½ | — ⅛ | *4 8 6 |
| Western Telegraph | 8 | 8 | 16½xd | — | *4 16 3 |
| **HOME RAILS.** | | | | | |
| Central London Ord. Assented | 4 | 4 | 83½ | — | 5 6 0 |
| Metropolitan | 1 | 1½ | 26 | — ½ | 4 16 6 |
| do. District | Nil | Nil | 24½ | — | Nil |
| Underground Electric Ordinary | Nil | Nil | 8½ | — ½ | Nil |
| do. do. "A" | Nil | Nil | 9/6 | —9d. | Nil |
| do. do. Income | 4 | 5 | 95 | — | *5 5 3 |
| **FOREIGN TRAMS, &c.** | | | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 4½ | — | 5 6 4 |
| Anglo-Arg. Trams. First Pref. | 5½ | Nil | 3½ | — ½ | — |
| do. do. 2nd Pref. | — | — | 8½ | — | — |
| do. do. 5 Deb. | 5 | 5 | 67½ | —1 | 7 9 0 |
| Brazil Tractions | — | — | 63½ | — | — |
| Bombay Electric Pref. | 6 | 6 | 11½ | — | 5 11 7 |
| British Columbia Elec. Rly. Pfce. | 5 | 5 | 57½xd | — | 8 14 9 |
| do. do. Preferred | Nil | 2½ | 46½xd | — | 5 7 6 |
| do. do. Deferred | Nil | Nil | 44½ | — | Nil |
| do. do. Deb. | 4½ | 4½ | 61½ | — | 6 17 10 |
| Mexico Trams 5 per cent. Bonds | Nil | Nil | 61½ | —1 | Nil |
| do. 6 per cent. Bonds | Nil | Nil | 50½ | — | Nil |
| Mexican Light Common | Nil | Nil | 88 | +1 | Nil |
| do. Pref. | Nil | Nil | 51 | — | Nil |
| do. 1st Bonds | Nil | Nil | 65 | —1 | — |
| **MANUFACTURING COMPANIES.** | | | | | |
| Babcock & Wilcox | 15 | 15 | 3¾ | — ⅛ | 8 18 0 |
| British Aluminium Ord. | 10 | 10 | 1½ | — | 5 14 5 |
| British Insulated Ord. | 25 | 12½ | 2⅛ | — | 5 11 1 |
| British Westinghouse Pref. | 7½ | 8 | 2½ | — | 5 16 5 |
| Callenders | 25 | 25 | 10½ | — ½ | 6 3 0 |
| do. 6½ Pref. | 5 | 6½ | 5½xd | — | 6 5 10 |
| Castner-Kellner | 25 | 20 | 2½ | — | 7 5 6 |
| Edison-Swan, "A" | — | — | 1½ | — | 6 0 0 |
| do. do. 5 per cent. Deb. | 4 | 5 | 74½xd | — | 6 12 10 |
| Electric Construction | 10 | 10 | 1⅞ | — | 8 8 5 |
| Gen. Elec. Pref. | 6 | 6½ | 10½xd | — | 6 8 0 |
| do. Ord. | 10 | 10 | 23 | — | *4 11 0 |
| Henley | 25 | 25 | 2½ | — | 8 2 6 |
| do. 4½ Pref. | 4½ | 4½ | 9½ | — | 6 0 0 |
| India-Rubber | 10 | 10 | 17½xd | — | *5 17 4 |
| Siemens Ord. | — | 10 | 7 | — | *7 0 0 |
| Telegraph Con | 20 | 20 | 25½ | — | 4 13 6 |

*Dividends paid free of Income Tax.

## MARKET QUOTATIONS.

**It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.**

### Wednesday, July 2nd.

| CHEMICALS, &c. | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|
| a Acid, Oxalic per lb. | 1/5 | .. |
| a Ammoniac Sal per ton | £80 | .. |
| a Ammonia, Muriate (large crystal) " | £78 | .. |
| a Bisulphide of Carbon " | .. | .. |
| a Borax " | £39 | .. |
| a Copper Sulphate " | £46 | £2 inc. |
| a Potash, Chlorate per lb. | 1/8 | .. |
| a " Perchlorate " | 1/6 | .. |
| a Sheilac per cwt. | £4 9 | £2 inc. |
| a Sulphate of Magnesia per ton | £10 | .. |
| a Sulphur, Sublimed Flowers " | £28 | .. |
| a " Lump " | £20 | .. |
| a Soda, Chlorate per lb. | 9d. | .. |
| a " Crystals per ton | £14[illegible] | .. |
| a Sodium Bichromate, casks per lb. | .. | .. |
| **METALS, &c.** | | |
| c Brass (rolled metal 3' to 12' basis) per lb. | 1/0½d. | ½d. inc. |
| c " Tubes (solid drawn) " | 1/3 to 1/4½ | ½d. inc. |
| c " Wire, basis " | 1/0½ | ½d. inc. |
| c Copper Tubes (solid drawn) " | 1/4½ | ½d. inc. |
| g " Bars (best selected) per ton | £121 | £4 inc. |
| g " Sheet " | £121 | £4 inc. |
| g " Rod " | £121 | £4 inc. |
| d " (Electrolytic) Bars " | £93 | £5 inc. |
| d " " Sheets " | £101 | .. |
| d " " Wire Rods " | £101 | £5 inc. |
| d " " H.C. Wire per lb. | 1/0½d. | ½d. inc. |
| f Ebonite Rod " | 4/- | .. |
| " Sheet " | 2/6 | .. |
| n German Silver Wire " | 2/6 | .. |
| h Gutta-percha, fine " | 11/- | .. |
| h India-rubber, Para fine " | 2/5½ | ½d. inc. |
| i Iron Pig (Cleveland warrants) per ton | Nom. | .. |
| l " Wire, galv. No. 8, P.O. qual. " | £42 | .. |
| g Lead, English Pig " | £23 10 | 10/- dec. |
| g Mercury per bot. | £21 | £1/£2 10 in. |
| e Mica (in original cases) small per lb. | 9d. to 4/6 | .. |
| e " " " medium " | 5/- to 10/- | .. |
| e " " " large " | 12/6 to 25/- & up. | .. |
| d Silicium Bronze Wire per lb. | 1/5 | .. |
| r Steel, Magnet, in bars per ton | .. | .. |
| g Tin, Block (English) " | £237 | £2 dec. |
| n " Wire, Nos. 1 to 16 per lb. | 4/- | .. |

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n F. Ormiston & Sons.
r W. F. Dennis & Co.

**Fuse Sizes for Motors.** — Tables are given in the *Electrical Review*, of Chicago, of March 15th, showing the starting fuse sizes recommended by the Westinghouse Electric and Manufacturing Company for various types of motors. The data are based on the following values of starting current:—

| Motors. | Times full load current at starting. |
|---|---|
| Polyphase wound motor | 1½ |
| Squirrel cage (thrown on line) | 3 |
| 1-phase repulsion induction with rheostat | 2 |
| " " " without rheostat | 4 |
| Direct current | 1½ |

Since the starting fuses for squirrel-cage and for repulsion motors without rheostats are rated respectively at three and four times full-load current, they give practically no overload protection under running conditions. In such cases double-throw switches should be provided, so that fuses rated at 1½ times full-load current may be switched in circuit for normal running. The tables cover D.C. motors up to 100 H.P.; 2-phase and 3-phase wound rotor induction motors up to 50 H.P.; 2-phase and 3-phase squirrel-cage motors up to 5 H.P.; and single-phase motors up to 10 H.P.

**Copper in Chile.** — Copper mining in Chile, though greatly hampered by war conditions, was, on the whole, more productive in the years of war than in previous years. This increased output of the mines was due to new methods of working and improved installations of plant. The most important of the Chilean copper mines, owned by the Chile Copper Co., which are among the largest in the world, possesses reserves estimated at 700,000,000 tons. These mines had, previous to the year 1918, a daily output of 27,000 tons. This huge production fell, in consequence of a shortage of fuel and shipping space, to 10,000 tons. But since the beginning of 1919 it has risen again to 15,000 tons. According to the *Wall Street Journal*, it is estimated that the production in 1919 will be: for the Chile Copper Co., about 100,000 tons; for the Andés Copper Co., about 50,000 tons; and for the Braden Copper Co., 75,000 tons. When the enlargement of the works now in progress has been completed, the Chile Co. will be in a position to produce 150,000 tons a year.—*Metall und Erz.*

# THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

(*Continued from Vol. 84, page 756.*)

## Electric Transmission.

By S. L. PEARCE, M.Sc., C.B.E.

(*Abstract.*)

Introduction.—It may be regarded as axiomatic that, other conditions being favourable, the correct location for a generating station is at the centre of gravity of the load. Departures from this rule will naturally arise as the result of:—

1. Conditions unfavourable for local generating stations.
2. Conditions particularly favourable for generation at some site more or less remote from the centre of gravity of the load.

Either of the above may be the determining factor, but in this country condition (1) is likely to be the predominating one.

Unfavourable conditions for local generation may include:—

(*a*) Cost of land.
(*b*) Excessive rates and taxes.
(*c*) Absence of cooling water facilities.
(*d*) Difficulty of bringing coal to the works, and also of disposing of ashes, &c.
(*e*) Risk of creating a nuisance.

Condition (2) may include:—

(*a*) Cheap land.
(*b*) Low rates and taxes.
(*c*) Good cooling water facilities.
(*d*) Good railway and coal-handling facilities, and conveniences for disposal of ashes.
(*e*) Ample facilities for extension, and no risk of creating a nuisance.
(*f*) More favourable conditions for economical generation under conditions of combined load and diversity factor, &c.

The case of a natural source of power will be of very rare occurrence in this country. Obviously, it might easily constitute, as in the United States and Canada, the sole factor governing the choice of site.

Whether arising from conditions (1) or (2), or both, it is obvious that the removal of the generating station from the centre of gravity of the load to some distant site may possess distinct advantages so far as *the actual cost of generation is concerned*. It therefore becomes necessary to examine to what extent the advantages of the distant site may be neutralised, or even outweighed, by the cost of transmission.

In this connection it is impossible to lay down any hard and fast rules, and it seems certain that it will always be necessary for *every specific case to be considered separately upon its merits*.

Transmission Charges and Losses.—Transmission may, for the purpose of comparison, be roughly divided into three primary forms (see fig. 1):—

*Case* 1.

A represents the centre of gravity of the load, but the generating station is located at S, and all the energy from S is delivered to A over the transmission line L.

*Case* 2.

This is similar to Case 1, but now, instead of the full output of S going to A, portions are tapped off at B and C, &c.

*Case* 3.

In this case S is the equivalent of, say, a super-station. It may be approximately at the centre of gravity of widely distributed load centres, A, B, C, D, E, &c.

In each of the above cases—which are purely diagrammatic—the single lines may represent duplicate conductors which do not necessarily follow the same route.

In Case 3 the load centres will probably be interlinked.

*Case* 1.—This is a simple case of point-to-point transmission. Proportionately it is the most expensive arrangement, as all the line and transformer charges are debited to the supply to A.

These charges include:—

(*a*) Capital charges on line.
(*b*) Maintenance and depreciation charges on line.
(*c*) Cost of energy loss on the line.
(*d*) Wayleaves and rating.
(*e*) Transformer losses.
(*f*) Capital charges on the necessary extra plant installed at S.

If the load at A = X, and full-load line loss $kx^2$, (where $k$ is a constant depending on the voltage and length of line) = $x$, then for the same margin of spares the plant capacity at S = X + $x$ + Y, where Y is the normal margin of spare plant. If $x$ is only small, then the increased risk will no doubt be taken with the plant X + Y, but where $x$ becomes appreciable this cannot advisably be done.

The line loss is proportional to $x^2$ and therefore falls off very rapidly as the load is reduced; hence, if the transmission losses are at all high, the effect on the load factor may be very considerable. This will affect the cost of generation and increase the cost of the line losses. If the line is an overhead one the regulation may be very bad, involving the additional expense of suitable apparatus for correcting the power factor.

*Case* 2.—This in its simplest form is but a modification of Case 1. It is naturally more economical than 1, because the average length of the transmission is obviously much shorter, and, moreover, there is a prospect of still further reduction in the transmission losses owing to the possible diversity in the loads at the several tapping centres.

*Case* 3.—This is likely to be the super-station condition, and it is the most satisfactory arrangement of the three, because, presumably, in the first case the station site S has been selected for the most favourable generating conditions. Owing to the overlapping of the separate demands the resulting diversity will improve the load factor, and the incidence of the line losses on peak load will not be so pronounced, and in any case *local load at* F, in the shape of electrochemical or electrometallurgical works, may be taken on to absorb the line loss plant during periods of average load.

In cases where the generation is by some natural source of power, such as water, then the incidence of the line losses becomes less important, and it may pay to transmit over very long distances with correspondingly high losses; but even under these conditions it seems difficult to justify—on purely economic grounds—a transmission component of the overall charges so high as 86 per cent., which, according to Mr. H. Kensit, is a figure actually obtained in one instance on the Ontario power scheme.

The same authority also states that on the whole system of the Hydroelectric Power Commission of Ontario the cost of transmission is approximately one half of the total cost of power as delivered in bulk.

Capital cost of line is independent of load factor, and is governed solely by possible maximum load; hence, it is dependent upon the diversity factor of the load.

As capital charges—at any rate in the case of hydroelectric schemes—form by far the largest percentage of the cost of transmission, it is clear that the magnitude of the peak load determines the price to the consumer more than the load factor of his own particular supply.

The losses in any transmission line are proportional to:—

(*a*) The square of the load.
(*b*) The length of the line.

and inversely proportional to:—

(*c*) The line pressure (for the same current density).

For known conditions of load it is, therefore, possible to calculate the loss under the most favourable conditions of pressure in any particular length of line, and the commercial practicability, or otherwise, of any particular scheme may be readily ascertained.

Interlinking.—The case of linking-up does not compare with that of direct transmission. The primary object of

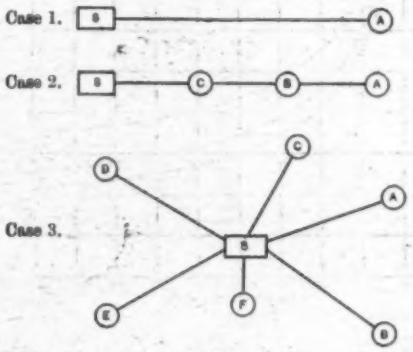



Fig. 1.

linking-up is to permit the floating interchange of power between two or more stations, and the main objects to be attained are:—

1. Increased reliability of supply.
2. Improvement of the load factor on the largest and most efficient plant.
3. Full advantage to be taken of diversity factor.
4. Plant, and therefore capital, utilised more economically.

The economical advantages accruing from such a scheme in industrial areas have been shown to more than compensate for the capital and running costs incidental to the necessary linking cables.

Points in Connection with Transmission Lines.—The first requirement of any transmission line—be it overhead or underground—is reliability, and this is an absolute essential in the case of a point-to-point system where there is no alternative supply route, as in the case of a linking-up system.

With the introduction of the very much higher voltages that are likely to be used in the near future, the great disparity in cost between overhead and underground lines largely

disappears. Strategic and climatic considerations also support the use of the latter.

It is very much open to question, therefore, whether the use of overhead lines is likely to be continued in the future, at any rate for main transmission and for interconnecting the new super-stations. Their extreme vulnerability to malicious damage and injury arising from aircraft accidents are factors which require serious consideration. In the less densely populated and comparatively undeveloped districts overhead lines will continue to be used as branch feeders and distributors.

For the same degree of reliability as would be obtained with the generating station at the centre of gravity of the load, it will be necessary for the lines to be at least completely duplicated, and preferably run by separate routes.

For reasons of economy and—in the case of underground lines—in order to maintain the cables in good condition, both sets should always remain in commission, as their sound condition is then assured and the line losses are greatly reduced, so much so, in fact, that the capital charges on the line will probably become the predominant factor in the transmission costs.

Experimental work has demonstrated so far that a 66,000-volt, 3-phase cable is both a commercial and technical probability; the use of cables will limit the line pressure, therefore, to approximately 66,000 volts. It will be a matter for serious consideration as to the extent to which it will be advisable to put spare copper into the cables, and it seems probable in many instances that copper in the cables may be a sounder financial proposition than extra plant to cover line losses.

The advantages of extra copper in the cables are:—

1. Greater cross-section with lower electrostatic strains.
2. Lower dielectric losses.
3. Reduced copper losses, and
4. A greatly increased margin of safety even at very high pressures.

This will mean lower maintenance cost, and will probably more than pay for the very slight increase in the overall cost of the transmission line.

If the load grows gradually, it may be necessary for copper to lie idle in the ground for some years, as the gradual increase of cable capacity to keep pace with the load would not be commercially practicable.

All the copper may, however, be used, and the resulting saving on the line losses, and the corresponding reduction of line loss plant, will probably largely cover the capital

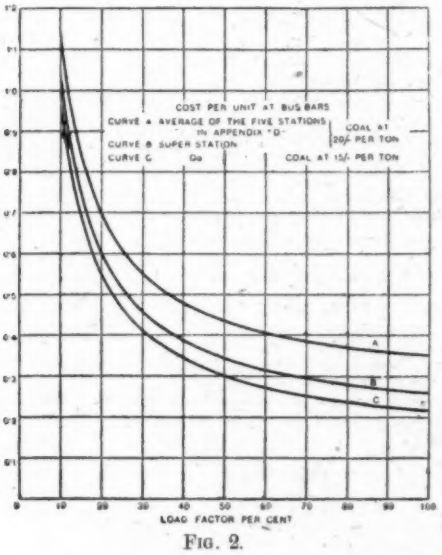



Fig. 2.

charges on the extra copper. More especially will this be the case if the present loan periods of 15 and 25 years are observed for plant and mains respectively.

The capital cost of lines (cable or overhead) is by no means proportional to the amount of copper only, whereas the loss *at any one pressure* is inversely proportional to the amount of copper. If, therefore, the loan period for cables is longer than for plant, it is quite probable that extra copper may be a better proposition than line loss plant, unless the latter can be economically employed on local load during "off peak" hours.

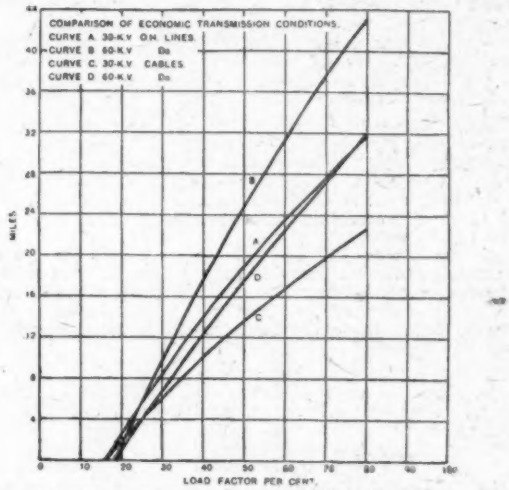
Number and Size of Cables.—The larger the scheme, the less the likelihood of a complete failure of supply due to cable breakdowns, because there would naturally be a greater number of main feeders, and the probability of a failure on more than one or two at the same time would be very remote. Consequently, the proportion out of commission would not involve dangerous overloads on the remaining sound cables. In other words, the greater the number of feeders in parallel, the less the importance of spares and the greater the factor of safety.

This consideration suggests a reasonable limit to the current-carrying capacity of E.H.T. cables, as in many cases it would undoubtedly be better policy to run two cables by separate routes than a single cable of an equivalent capacity.

A further advantage is the reduced temperature rise, and consequently increased permissible current density, in the case of the smaller cables. This reduction in size of conductor is, however, ultimately limited by the greatly increased electric stress on the dielectric, and also by economic considerations.

Overhead Lines.—Within the limits of excessive corona losses and excessive capital charges, it is usually advisable to work at the highest possible line pressure, if only for the following reasons:—

(*a*) Reduced capital expenditure (within limits).
(*b*) Lower percentage line loss (for same current density).
(*c*) Owing to the lower line current at the higher pressure, the inductive drop is reduced.
(*d*) Owing to the higher value of the line pressure, the inductive drop becomes of less importance, unless indirectly increased by the necessary greater distance between the separate phases.




Coal at 20s. per ton. The curves show the distance to which electricity generated in a super-station can be transmitted at an over-all cost equal to the cost of generation in a local station (curve A, fig. 2).

Fig. 3.

Owing to the prohibitive increase in the $C^2R$ losses and the voltage drop on long lines, the capital charges would increase in a greater ratio than the mileage, unless the line pressure were raised, as shown in Appendix F.

This emphasises the importance of increasing the voltage to the highest possible commercial value on long lines. Obviously, however, there must be a limiting value for the pressure, and this will be reached when the corona losses become comparable with the $C^2R$ losses at a lower pressure, and the increased capital charges arising from the more expensive features of the line construction and switchgear equal, or exceed, those on the increased weight of copper at a lower pressure.

In comparison, it is interesting to note that the transformation costs are not directly affected to any great extent by the length of the line, but only indirectly by the possible corresponding alteration in line pressure.

Advantages of High Pressures.—In the case of both cables and overhead lines it is, within limits, usually advantageous to have the pressure as high as possible, because the higher pressure means a smaller current for the same power, and therefore there will be less likelihood of trouble due to surges, &c. The capacity and dielectric loss effects with cables will become more pronounced as the pressure is increased. To some extent these effects are advantageous, since one serves to correct the power factor of the system and the other acts as a relief valve for high frequency surges. The electrostatic storage of energy on a large E.H.T. cable system is, however, very considerable, and great care must be exercised in order to avoid accidental discharge of the system as a condenser. Static effects of this description are greatly minimised by the earthing of the neutral point.

In order to reduce the temperature rise and increase the factor of safety, the sectional area of all E.H.T. cables could be increased with advantage in the immediate neighbourhood of the generating and principal sub-stations.

Cost of Losses.—Copper losses in lines and transformers should not be debited with the same cost as magnetising and dielectric losses, owing to their low load factor. In fact, it is difficult to resist the conclusion that they should be debited with all the capital charges on the extra "line loss plant," provided that the latter is not employed otherwise during "off peak" hours.

Economical Considerations.—In the case of overhead transmission at comparatively low pressure, the most economical section of conductor can usually be arrived at by the applica-

tion of Kelvin's law. This law merely relates the annual cost of the $C^2R$ losses to the annual interest and depreciation charges on the conductors.

Equality of these two charges obviously gives the most economical working conditions, and with comparatively short lines, and where the cost varies closely in proportion to the total amount of copper, the resulting cross-section of conductor is usually a satisfactory one.

Although in some cases useful as a rough preliminary guide, Kelvin's law is not generally applicable to present-day schemes, for neither in the case of E.H.T. overhead lines nor super-tension cables is the capital cost by any means proportional to the section of the conductors.

In the case of long lines, if the cost of generation is low the line regulation may be the factor governing the section of conductor, and similarly in the case of super-tension cables permissible current density may be limited by the maximum safe working temperature of the dielectric.

On long overhead lines the voltage drop usually becomes excessive before the load exceeds economical limits. If synchronous condensers are used the line drop may be reduced to negligible proportions, but the efficiency of the transmission line is appreciably reduced, and this factor may ultimately limit the economical load.

Careful consideration of the probable ultimate load is, however, of the utmost importance, and it is safe to say that in every case the line losses will not attain their maximum value for several years.

LOAD FACTOR.—In view of the universal demand for a shorter working week, it appears probable that load factors may not (at least for some years) attain the values anticipated unless two-cycle working shifts become generally adopted.

Appreciable reduction of load factor will have a very marked effect on the economical aspect of super-station generation and transmission.

In this connection the *main line* railway load should ultimately becomb a desirable one, for with a short headway passenger service during the day and a dense goods service during the night, the load factor may be expected to attain a fairly high value. The figure given for an American line was 70 per cent.

CHOICE OF ROUTE FOR TRUNK LINE CABLES.—Convenient laying and maintenance conditions require that the cables should be laid along well defined and accessible routes.

Virgin ground is obviously most undesirable.

The most suitable location is undoubtedly under the main high roads, as it possesses the following, amongst other, advantages:—

1. Usually the shortest convenient route between important centres, and also the most well defined.
2. The high roads provide a hard and well-settled sub-soil with a minimum risk of subsidence.
3. Advantage of extreme accessibility, both for laying and subsequent maintenance.
4. Convenient for transport of cable and material.
5. Not likely to be disturbed by future building operations, or town planning schemes, &c.
6. Alternative routes frequently available.

It has been suggested that the trunk cables should be run alongside the railways, but it is difficult to see what great advantages such routes offer, and it is certain that they possess certain disadvantages, amongst which are the following:—

1. Railways in many cases do not follow the best routes, and they may necessitate considerable detours.
2. As a rule there is very little room available at the side of the track, especially for the number and size of transmission lines contemplated in the future.
3. The obvious difficulty of laying the cables in cuttings and tunnels, and over viaducts and embankments.
4. Difficulties incidental to laying and maintenance greatly increased, and probability of cables being frequently inaccessible.
5. Great risk of damage to cables in the event of derailment or other accidents on the railway.

It is obvious from the considerations set forth in the introduction to these notes that there can be no justification for a transmission scheme, as compared with a local generating station—so far as the economic aspect of the matter is alone concerned—unless the current can be delivered at the busbars to the feeders at a price low enough to counterbalance the transmission and transformation charges.

The author believes, however, that in future it will be impossible to shut out altogether other influencing considerations and to determine policy on the lines of the economic aspect alone.

With a view to giving a lead to the discussion, and in order to test the opinions of the members, the author has put forward in the appendices certain concrete examples of transmission costs under varying conditions, together with certain data and estimates relating to the costs of production at existing and future power stations.

The estimates have been carefully prepared, for the most part upon data supplied by several manufacturers, and are believed to be as reasonably, or at any rate as relatively, accurate as present-day circumstances will permit for costing.

It is hoped that a consideration of these notes, the figures submitted, and the discussion resulting therefrom may assist in a truer appreciation of the problem of electric transmission.

In conclusion, the author wishes to acknowledge the assistance he has received in the preparation of these notes from Mr. L. R. Lee and Mr. H. A. Ratcliff, of the Manchester Corporation Electricity Department.

APPENDIX A.—Comparative costs of underground and overhead transmission at 33,000 volts between two generating station sites in the Manchester district.

Carrington to Barton (Manchester) = 4 route miles. Power transmitted, 100,000 KW. at 60 per cent. load factor. Power factor, 0.8. Pre-war prices. Copper basis = £100 per ton.

A. UNDERGROUND TRANSMISSION AT 33,000 VOLTS.

| | £ |
|---|---|
| 1. *Capital Costs*— | |
| (*a*) 9 cables ... ... ... ... ... ... | 117,000 |
| (*b*) Trenching and reinstatement ... ... | 12,000 |
| (*c*) Jointing ... ... ... ... ... ... | 3,500 |
| (*d*) Laying ... ... ... ... ... ... | 1,500 |
| | £134,000 |
| 2. *Annual Standing Charges*— | |
| (*a*) Interest and sinking fund at 8 per cent. ... | 10,720 |
| (*b*) Maintenance at 1 per cent. ... ... ... | 1,340 |
| 3. *Annual Running Charges*— | |
| Line losses, taken at 0.275d. per Kelvin* ... | 7,810 |
| 4. *Total Annual Costs* ... ... ... ... ... | £19,870 |

B. OVERHEAD TRANSMISSION AT 33,000 VOLTS.

| | £ |
|---|---|
| 1. *Capital Costs*— | |
| Overhead lines complete ... ... ... ... | 55,000 |
| 2. *Annual Standing Charges*— | £ |
| (*a*) Interest and sinking fund at 10 per cent. ... | 5,500 |
| (*b*) Maintenance at 3 per cent. ... ... ... | 1,650 |
| 3. *Annual Running Charges*— | £ |
| Line losses, taken at 0.275d. per Kelvin ... ... | 11,910 |
| 4. *Total Annual Costs* ... ... ... ... ... | £19,060 |

NOTE.—No wayleaves required in either case. Rating approximately the same in each case. Cable prices based on a firm quotation in October, 1913. Overhead line prices based on a cable maker's estimate.

APPENDIX B.—Cost of transmitting 100,000 KW.—under the conditions stated—from the Merseyside to the Manchester area by means of a 150,000-volt overhead line and 5 miles of underground cables.

Merseyside to Manchester = 38 route miles. Power transmitted, 100,000 KW. at 60 per cent. load factor. Power factor, 0.8. 33 miles of duplicate overhead lines at 150,000 volts. 5 miles of underground cables at 40,000 volts. Copper basis, £100 per ton.

| | £ |
|---|---|
| 1. *Capital Costs*— | |
| (*a*) 33 miles of overhead lines ... ... ... | 360,000 |
| (*b*) 5 miles of underground cables ... ... | 200,000 |
| (*c*) Step-up and double step-down transformers, E.H.T. switchgear and sub-station buildings... | 625,000 |
| 2. *Annual Standing Charges*— | |
| (*a*) Interest and sinking fund on overhead lines at 10 per cent. ... ... ... ... ... | 36,000 |
| (*b*) Interest and sinking fund on cables and plant, &c., at 8 per cent ... ... ... ... | 65,000 |
| (*c*) Maintenance on overhead lines at 3 per cent. | 10,800 |
| (*d*) Maintenance on cables and plant at 1 per cent. ... ... ... ... ... ... ... | 8,250 |
| (*e*) Wayleaves ... ... ... ... ... | 900 |
| (*f*) Rating (approximate) ... ... ... ... | 20,000 |
| 3. *Annual Running Charges*— | £ |
| (*a*) Overhead line losses at 0.275d. per Kelvin ... | 7,080 |
| (*b*) Cable losses at 0.275d. per Kelvin ... ... | 4,130 |
| (*c*) Transformer losses (3 × 2 per cent) at 0.2d. per Kelvin ... ... ... ... ... ... | 26,250 |
| 4. *Total Annual Costs* ... ... ... ... ... | £179,360 |
| 5. *Cost per Kelvin delivered in Receiving Area* ... | .082d. |

NOTE.—Above prepared on 1917 prices for items other than copper.

APPENDIX C.—Underground cables throughout at 40,000 volts; conditions outlined in Appendix B.

| | £ |
|---|---|
| 1. *Capital Costs*— | |
| (*a*) 36 miles of cable laid ... ... ... ... | 1,675,000 |
| (*b*) Transformers, switchgear, and buildings ... | 450,000 |
| 2. *Annual Standing Charges*— | £ |
| (*a*) Interest and sinking fund on cables and plant, &c., at 8 per cent. ... ... ... ... | 170,000 |
| (*b*) Maintenance on cables and plant, &c., at 1 per cent. ... ... ... ... ... ... | 21,250 |
| (*c*) Rating (approximate) ... ... ... ... | 20,000 |

* Kelvin = Board of Trade unit.

| | £ |
|---|---|
| 3. *Annual Running Charges*— | |
| (a) Cable losses at 0.275d. per Kelvin ... ... | 31,350 |
| (c) Transformer losses (3×2 per cent.) at 0.2d. per Kelvin ... ... ... ... ... ... | 17,500 |
| 4. *Total Annual Costs* ... ... ... ... ... | £260,100 |
| 5. *Cost per Kelvin delivered in receiving area* ... | 1185d. |

NOTE.—Above prepared on 1917 prices for items other than copper.

## APPENDIX D.

Particulars relating to the total cost in pence per kelvin delivered to feeders from certain typical existing stations in Cheshire, Lancashire and Yorkshire. Year ending March 31st, 1918.

| Kilowatts installed. | Percentage of plant running on Cooling towers. | Percentage of plant running on Canal or river supply. | Kelvins dd. to feeders per annum. | Load factor. Per cent. | Total cost in d. per kelvin dd. to feeders.* |
|---|---|---|---|---|---|
| 20,890 | 100 | Nil | 59,818,630 | 31·4 | ·475 |
| 7,200 | Nil | 100 | 15,683,556 | 37·8 | ·510 |
| 41,800 | Nil | 100 | 66,717,696 | 32·08 | ·710 |
| 67,750 | 80 | 20 | 199,330,250 | 41·8 | ·520 |
| 58,500 | 50 Summer / Nil Winter | 50 Summer / 100 Winter | 167,898,373 | 39·5 | ·456 |
| 11,000 | Nil | 100 | 26,737,350 | 35 | ·541 |

* Corrected for coal at 20s. per ton, inclusive of all capital charges on station.

NOTE.—The above costs are not strictly comparable, *e.g.*, cost of management and income tax are in certain cases excluded, whilst capital charges vary.

## APPENDIX E.

Estimated costs per kelvin delivered to feeders from future super-power stations.

*Present-day costs.*

| | 60 % load factor. | 40 % load factor. |
|---|---|---|
| Coal ... ... ... ... ... | ·175d. | ·182d. |
| Oil, water and stores ... ... ... | ·002 | ·002 |
| Repairs and maintenance ... ... | ·018 | ·025 |
| Wages and salaries ... ... ... | ·018 | ·025 |
| Rates and administration ... ... | ·015 | ·021 |
| Capital ... ... ... ... ... | ·090 | ·135 |
| Total ... ... ... | ·318 | ·390 |

Capital charges, £22 per K.W.T.; equated figure for interest and sinking fund, 9 per cent.; coal consumption, 18,000 B.TH.U. per kelvin delivered to feeders; coal cost per ton, 20s.

CORRECTIONS FOR VARYING COAL COSTS (shillings per ton).

| Coal at ... ... | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total cost... | ·273 | ·282 | ·291 | ·300 | ·309 | ·318 | ·327 | ·336 | ·345 | ·354 | ·363 |

## OVERHEAD CONDUCTORS (Appendix F).

| | | Volts. | 10 miles. £ | 20 miles. £ | 30 miles. £ |
|---|---|---|---|---|---|
| Capital costs ... ... | | 30,000 | 747,000 | 1,044,000 | 1,341,000 |
| | | 60,000 | 748,000 | 946,000 | 1,144,000 |
| Annual standing charges. | Interest and sinking fund* | 30,000 | 65,700 | 95,400 | 125,100 |
| | | 60,000 | 63,800 | 83,600 | 103,400 |
| | Maintenance† | 30,000 | 13,410 | 22,320 | 31,230 |
| | | 60,000 | 11,440 | 17,380 | 23,320 |
| | Rating and wayleaves. | 30,000 | 5,000 | 10,000 | 15,000 |
| | | 60,000 | 5,000 | 10,000 | 15,000 |
| Annual running charges (cable & transformer losses) | | 30,000 | 32,500 | 47,500 | 62,500 |
| | | 60,000 | 27,500 | 37,500 | 47,500 |
| Total annual costs ... | | 30,000 | 116,610 | 175,220 | 233,830 |
| | | 60,000 | 107,740 | 148,480 | 189,220 |
| Cost in d. per kelvin delivered. | At 60 per cent. L.F. | 30,000 | ·053d. | ·08d. | ·106d. |
| | | 60,000 | ·049d. | ·0675d. | ·087d. |
| | At 40 per cent. L.F. | 30,000 | ·074d. | ·110d. | ·147d. |
| | | 60,000 | ·068d. | ·093d. | ·120d. |

Line losses calculated at 0·275d. per kelvin (L.F. 60 p.c.); 0·30d. (L.F. 40 p.c.).

Transformer losses calculated at 0·224d. per kelvin (L.F. 60 p.c.); 0·24d. (L.F. 40 p.c.).

The above figures of present day costs are given with reserve and are probably somewhat underestimated.

## UNDERGROUND CABLES (Appendix G).

| | | Volts. | 10 miles. £ | 20 miles. £ | 30 miles. £ |
|---|---|---|---|---|---|
| Capital costs ... ... | | 30,000 | 1,055,580 | 1,661,160 | 2,266,740 |
| | | 60,000 | 1,027,920 | 1,505,840 | 1,983,760 |
| Annual standing charges. | Interest and sinking fund‡ | 30,000 | 84,446 | 132,888 | 181,336 |
| | | 60,000 | 82,232 | 120,464 | 158,696 |
| | Maintenance§ | 30,000 | 10,556 | 16,611 | 22,667 |
| | | 60,000 | 10,279 | 15,058 | 19,837 |
| | Rating ... | 30,000 | 5,000 | 10,000 | 15,000 |
| | | 60,000 | 5,000 | 10,000 | 15,000 |
| Annual running charges (cable & transformer losses) | | 30,000 | 38,500 | 59,100 | 79,700 |
| | | 60,000 | 26,750 | 35,600 | 44,450 |
| Total annual costs ... ... | | 30,000 | 138,500 | 218,600 | 298,700 |
| | | 60,000 | 124,261 | 181,100 | 238,000 |
| Cost in d. per kelvin delivered. | At 60 per cent. L.F. | 30,000 | ·0632d. | ·0998d. | ·136d. |
| | | 60,000 | ·0566d. | ·0827d. | ·108d. |
| | At 40 per cent. L.F. | 30,000 | ·0886d. | ·138d. | ·181d. |
| | | 60,000 | ·0815d. | ·118d. | ·154d. |

* 10 per cent. on lines, 8 per cent. on plant.
† 3 per cent. on lines, 1 per cent. on plant.
‡ 8 per cent. on cables and plant.
§ 1 per cent. on cables and plant.

## APPENDIX F.

Data relating to the transmission of 100,000 KW. at 0·8 power factor, distances of 10, 20 and 30 miles, 33,000 and 66,000 volts, by overhead lines.

*Per 10 miles.*

| Voltage at receiving end. | No. of circuits. | Size of conductor. | Full load voltage drop. | | Copper loss. Full load. | | Copper loss. Units expressed as a percentage of units sold. Load factor, per cent. 100 | 60 | 40 | Present-day costs. Total cost per 10-mile run. | 20-mile run. | 30-mile run. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sq. in. | Volts. | Per cent. | Total KW. | Per cent. | | | | £ | £ | £ |
| 30,000 | 12 | 0·2 | 2,030 | 6·77 | 3,240 | 3·2 | 3·2 | 2·48 | 2·02 | 297,000 | 594,000 | 891,000 |
| 60,000 | 6 | 0·2 | 2,236 | 3·72 | 1,614 | 1·6 | 1·6 | 1·24 | 1·01 | 206,600 | 412,200 | 619,800 |
| 60,000 | 6 | 0·15 | 2,380 | 3·97 | 2,160 | 2·2 | 2·2 | 1·65 | 1·35 | 198,000 | 396,000 | 594,000 |

Current per conductor, 200 amperes. Three poles abreast. No duplicate lines included.

## APPENDIX G.

Data relating to the transmission of 100,000 KW. at 0·8 power factor, distances of 10, 20 and 30 miles at 33,000 and 66,000 volts by underground cables.

*Per 10 miles.*

| Voltage at receiving end. | No. of cables. | Size of conductor. | Current per conductor per cable, (Amperes.) | Full load voltage drop. | | Copper loss. Full load. | | Loss expressed as a percentage of units delivered in receiving area. Load factor, per cent. 100 | 60 | 40 | Present-day costs. Total cost per 10-mile run. | 20-mile run. | 30-mile run. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sq. in. | | Volts. | Per cent. | Total KW. | Per cent. | | | | £ | £ | £ |
| 30,000 | 12 | 0·15 | 200 | 1,120 | 3·73 | 4,650 | 4·65 | 4·65 | 3·42 | 2·74 | 605,580 | 1,211,160 | 1,816,740 |
| 30,000 | 10 | 0·25 | 241 | 835 | 2·78 | 3,480 | 3·48 | 3·48 | 2·56 | 2·05 | 625,820 | 1,251,640 | 1,877,460 |
| 60,000 | 7 | 0·15 | 172 | 962 | 1·6 | 2,005 | 2·0 | 2·0 | 1·47 | 1·18 | 477,920 | 955,840 | 1,433,760 |

Average conductor temperature taken to be 120° Fahr. for 100 per cent. load factor, 100° Fahr. for 60 per cent. load factor, and 90° Fahr. for 40 per cent. load factor.

Dielectric losses on the 33,000 and 66,000-volt cables are about 1 watt and 3 watts per yard respectively, and are therefore only quantities of the second order. In the above schedule the dielectric losses have been ignored because they are fully counterbalanced by the beneficial effect of the cable-charging current on the power factor of the system.

No spare cables included.

In the course of reading the paper, Mr. Pearce pointed out, with reference to fig. 3, that the crossing of the 30 and 60-KV. curves at a comparatively short mileage indicated the advantage of using the higher pressure in the case of both cables and overhead lines. The reason for the curves crossing was the higher cost of the 60-KV. switchgear. These curves showed very clearly the importance of a high load factor on a transmission system. He added that it would be obvious that the curves on fig. 3 must be regarded as more or less elastic, and therefore they must be used with considerable discretion. The economic transmission mileage was governed by the *difference* between the super-station cost and the average station cost, and not by the actual values of such costs; consequently a very small reduction in the super-station cost would result in a very appreciable increase of the permissible transmission mileage.

The two following cases would serve to illustrate the importance of this point, and it should be noted that no allowance had been made for the slight reduction in the value of the annual line charges due to the lower generating costs:—Taking the case of the 30-KV. cable scheme and a system load factor of 60 per cent. The permissible transmission distance was seen from fig. 3 to be 16.8 miles, this value being based on the same coal cost of 20s. per ton at both the average station and super-station. If however, for any reason coal could be obtained at the super-station for 15s. per ton, the resulting effect would be as follows:—

Reduction in cost of coal, 25 per cent.

Reduction in total cost per unit at busbars, 13.8 per cent.

Increase in difference between super-station and average station costs, 48.5 per cent.

Corresponding increase in transmission mileage, 69.5 per cent.

New value of transmission distance, 28.5 miles.

Similarly in the case of the 60-KV. cable scheme, with a system load factor of 60 per cent.; with coal at 20s. per ton the permissible transmission distance was 22.4 miles, but with coal at 15s. per ton the values became:—

Permissible transmission distance, 39.1 miles.

Increase in transmission mileage, 74.5 per cent.

If, therefore, owing to exceptionally favourable location, or for other reasons, the cost of coal at super-stations could be appreciably reduced, then the long-distance transmission of electrical energy from such stations would take on quite a new aspect. This emphasised the tremendous importance of an abundant supply of cheap, or relatively cheap, coal, for the projected super-stations.

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### DISCUSSION.

In opening the discussion, Mr. B. WELBOURN said he agreed that every case must be treated on its own merits; he considered that main transmission must be by underground cable, but overhead lines could be used for distribution. Dealing at some length with Appendixes F and G, he pointed out that a considerable portion of the capital and annual charges arose from the step-up transformers, and went on to give particulars of some 4,000-KW. hydro-electric plants, generating at 33,000 volts, which were installed in 1906 at Subiaco, in connection with the supply to Rome. These had proved so satisfactory that two additional sets were installed about two years ago. The principal troubles which had been experienced had been due to lightning disturbances, which had been carried back to the generators through the overhead wires. He pointed out the importance of investigating the possibilities of 30,000-volt generation in this country, where lightning troubles could be avoided by the use of underground cables, and called attention to the saving effected in capital cost, space, and running charges if this were done. He had only had the paper in his hands for a few hours, but, in view of the tremendous increase in the cost of overhead line work during the war, he thought it probable that the figures in Appendix F were on the low side; he was sure that those in Appendix G were on the high side, and could be considerably reduced. The probable explanation of the discrepancy was that the figures in Appendix G were based on higher values for copper and lead than were now ruling. Mr. Welbourn called attention to the statement that on the 33,000 and 66,000-volt cables, the dielectric losses would be about 1 watt and 3 watts per yard respectively, and were, therefore, only quantities of the second order. He could not accept this statement as it stood, and asked for detailed information as to the way in which these dielectric losses had been measured. In his opinion, the only figures which would be of real value to a cable user would be those obtained from measurements made under the running conditions of each particular system. In order to judge power-factor figures for cables in their right light it was, in his opinion, necessary to know the wave form and frequency of the alternator; the temperature of the cable under test; the dielectric stress per millimetre; the phase angle of the transformers employed; the type of high tension wattmeter used; and the precautions taken to ensure accuracy. There were considerable differences of opinion as to the right way of making power-factor tests, and it was desirable that some common standard should be adopted, so that results obtained by different workers should be directly comparable. He believed that *under actual working conditions* the figures for dielectric losses would be much nearer 2 and 6 than 1 and 3. On this basis, and assuming 300 miles of cable connected to a super-station, the actual 100 per cent: load-factor energy loss at 30,000 volts would be about 700 KW., and at 60,000 volts it might easily be between 3,000 and 4,000 KW. at full load, and these losses would, for the most part, be constant whether any load was being delivered by the cable or not. At the present time, the figures for 60,000-volt cables were necessarily somewhat theoretical, but it appeared probable that on the 60,000-volt, 0.15 sq. in. cable mentioned by Mr. Pearce, the $C^2R$ losses would be about 129,000 KW.-hours per mile per annum at 60 per cent. load factor, while the dielectric losses would be about 100,000 KW.-hours, so that the latter could not be considered quantities of the second order. Mr. Welbourn also questioned the permissible current per conductor allowed by Mr. Pearce. For the temperature rise allowed he would pass 287 amperes instead of 241 along the 0.25 sq. in. 30,000-volt cable, but only 166 against 172 in the 0.15 sq. in. 60,000-volt cable. Seeing that 30,000-volt cables were in the region of reality, and 60,000-volt cables were still only in the region of experiment, and taking the above considerations into account, he thought that a very much better case would be made out for a 30,000-volt cable at the present time than for a 60,000-volt one. According to Mr. Pearce's figures, the tables showed a difference between overhead and underground construction at 60 per cent. load factor of 0.03d. per kelvin at 30,000 volts, and 0.021d. per kelvin at 60,000 volts, and at 40 per cent. load factor there was a difference of 0.034d. at both voltages, so that one would expect at load factors below 40 per cent. that there was no advantage in going above 30,000 volts for distances up to 30 miles. Mr. Welbourn said that he had the permission of Mr. Wordingham to describe briefly the work which was being done by two I.E.E. committees for the benefit of the electric supply industry:—

(*a*) A committee had been sitting for some years dealing generally with the heating of cables, and some nine months ago a special sub-committee was set up to deal with the heating of extra-high-pressure armoured cables only. This sub-committee had drawn up an extensive programme of work which would probably take two years to carry through, but, in view of the importance of the subject at the present time, when large cable transmission schemes were being planned, it should be of considerable assistance to the industry to call attention to one provisional result obtained. For the same temperature rise, an armoured cable laid direct in the ground would carry approximately 30 per cent. more current than a corresponding plain lead-covered cable drawn into a dry glazed stoneware duct. This created a serious problem for those who had to lay transmission cables in cities and, in any case, the bunching of cables should be avoided, because of the difficulty in dissipating the heat given off. In some cases ducts must be used, and it would appear necessary in designing such systems either to put in extra copper or to resort, as in the U.S.A., to artificial cooling of the ducts. It was also advisable to protect cables laid on posts, walls, &c., from direct sunshine.

(*b*) At Mr. Wordingham's request, the I.E.E. set up a large overhead power lines committee about three months ago to co-ordinate the existing regulations of the various Government departments dealing with overhead power conductors. The work was being done by a number of sub-committees, and it was hoped, during this year, to have ready for the guidance of the Electricity Commissioners, two sets of rules, one dealing with extra-high-pressure lines and the other dealing with distribution networks and lines. A good deal of criticism had been directed for some years against the existing B.O.T. regulation which called for a factor of safety of 5 on conductors at 22 deg. F., and 25 lb. per square foot wind pressure on 0.6 of the projected area of the conductor, but with no allowance for snow, ice, or elasticity. It was probable that the committee would suggest a modification providing that, in the case of extra-high-pressure schemes, the conductors of all sizes, material, and voltage should be erected so that the stress occurring under weather conditions involving a radial thickness of half an inch of ice coating at a temperature of 22 deg. F., and a simultaneous wind pressure of 13.5 lb. per sq. ft., taken upon 60 per cent. of the conductor projected area, should not exceed one-half of the breaking stress of the conductors, full allowance being made for the elasticity of the conductor.

Mr. J. F. WATSON thought the dielectric losses were underestimated in the paper; he suggested 1 and 4 watts instead of 1 and 3.

Mr. W. M. SELVEY said it was useless to pretend that a thing could be done if they really believed it could not; they must be honest, and Mr. Pearce's paper was exceptionally honest. But he begged the whole question when he referred to the station being at the centre of gravity, other things being equal. The efficiency of transportation of coal in terms of fuel consumption was enormous—a ton of coal could be carried 10 miles for a consumption of 1 lb. of coal. There were many cases where the cost of fuel did not come into the question at all, such as waste heat recovery plants, &c. He was in practical agreement with Mr. Pearce's figures, which were summed up in fig. 3. It would appear from a comparison between 30 miles away and a local station that the cost of transmission brought about a balance at 10 miles; hence the future generating stations should be 20 miles apart. With regard to fuel economy, the ideal system would be that the

electrical engineer should be responsible for the total fuel consumption and the whole supply of power in his district; that would be a great incentive to economy.

Mr. S. E. Fedden expressed his high appreciation of the paper, which he regarded as most valuable to all electrical engineers. His own case paralleled case 1 of the paper. Two years ago, after full investigation, he placed the limit of transmission at 10 or 15 miles; it was cheaper to bring coal to the best local site than to transmit electrical energy 30 or 40 miles. The proposals to lay transmission lines along railways, and to distribute energy from the trunk lines, were absurd; the latter would necessitate looping-in to sub-stations, and only a big demand could make it a paying proposition. With regard to interlinking, he objected to running a big system linked up; he would provide the links, but would keep them normally open, to prevent big disturbances in case of a breakdown. If continuity of supply was to be maintained, all main transmission and distribution lines would have to be underground. Foreign countries in which overhead mains were used had to put up with interruptions. He would welcome the 66,000-volt cables; hitherto he had only calculated on 33,000 volts. The 47-hour week would have a serious effect on the load factor, and this would tell still more in favour of the local than of the superstation. As for laying cables under roads, they would have to take up the whole roadway to find room for them; there would be great difficulty in providing accommodation for these mains. Superstations might save coal, due to the use of a higher vacuum; but it would be at the expense of the consumer. Curve C, fig. 3, was based on the difference between curves A and B on fig. 2; B was for an ideal station, A for old stations. To make a fair comparison they should compare ideal stations at both sites.

Mr. C. J. Beaver said that the author's view with regard to the relative merits of overhead and underground cables was shared by the best authorities; the overhead line had small capacity compared with inductance, whilst in the underground cable capacity predominated, and had a beneficial effect on the system. Of the two components of an electricity supply undertaking the generating plant appeared to be regarded as satisfactory, while the transmission line afforded room for improvement. The cable maker had to increase the maximum stress in the dielectric as compared with present practice, but it was generally agreed that 60,000 volts would be the maximum needed in this country. Mr. Beaver exhibited a diagram which he had prepared, showing the relations between the various factors in the problem, and pointed out that the voltage drop was the primary consideration; but each case must be considered on its merits. The value given in the paper for the watts lost in the high-voltage cable was much too low. With regard to the laying of cables alongside of railways he said that there were serious disadvantages attaching to this procedure; the vibration due to the traffic would be detrimental to the cables, and there would be serious risk of electrolysis when the railways were electrified.

Mr. C. H. Wordingham said he had recently investigated the cost of transmitting large quantities of energy over large areas, and had not found that the overhead system offered no advantages; must we suppose that other countries, which used overhead mains freely, were all wrong? Why did we alone prefer underground cables? Possibly we were biased by the leading position which this country had always occupied in the manufacture of cables, and we had had less experience with overhead transmission. Overhead conductors were more easily and quickly repaired, and snow was of no account at all on heavy lines; the load capacity of the mains was easily increased. Why was so much stress laid on the subject of interruptions? During the war Paris had been bombed on innumerable occasions, but none of the overhead lines had suffered damage. Flying accidents must be taken into account in future, especially by the airmen. With reference to the use of railways as routes for mains, Mr. Wordingham cited the case of the original trunk mains from Deptford, all four of which were successively put out of action by a fire which occurred in a railway arch. Railways were entirely unsuitable for the purpose, and the arguments which had been put forward for combining electricity supply with railway working on that score were absurd.

Mr. W. Burr said he was pleased to hear Mr. Wordingham's remarks in favour of the overhead system. In South Wales they had not had many interruptions, and breakdowns were easily and quickly repaired.

Mr. R. A. Chattock said that opinion was generally favourable to underground cables; these must be used on entering populous districts, and the addition of the necessary transformers between the overhead and underground mains increased the expense and the risk of breakdown. The overhead system must inevitably be more vulnerable to interference, and reliability of supply was of pre-eminent importance, hence the underground system was the right one for this country. The atmosphere of industrial areas was bad for overhead mains; in Birmingham the air was acid and corroded metals exposed to its influence. Twenty per cent. more power could be transmitted through cables laid solid than through cables drawn into ducts. Mr. Pearce held that it was highly undesirable to lay cables in virgin soil, but the saving of labour in laying cable in agricultural land was important, and wayleaves for cables were much cheaper than for pole lines. Mr. Pearce had not drawn the conclusions from his data that he might have; the extra cost of a 20-mile transmission amounted to 20 per cent. of the cost of generation, and a local station with cooling towers showed an advantage of 10 or 12 per cent.

Mr. E. C. Hoadley said that at Maidstone the 47-hour week, with overtime forbidden, presented a serious problem; but by arrangement with the local factories the men had been induced to work two shifts—7 a.m. to 5 p.m. and 11 p.m. to 7 a.m.—so that they were able to see the "pictures," while the works maintained their output and the station got a high load factor.

Mr. Pearce said that he would reply fully in the *Proceedings*.

## DEVELOPMENTS IN THE CANADIAN MARKET.

(*Report by H.M. Trade Commissioner.*)

A report* on the trade of Canada (particularly Ontario) and Newfoundland by His Majesty's Trade Commissioner at Toronto (Mr. F. W. Field) has recently been issued by the Department of Overseas Trade.

The following is a summary of the points which should prove of interest to electrical and allied manufacturers.

**Ontario Hydro-Electric Power Commission.**

The power obtained from the generating stations at Niagara passes through a transforming station, and is stepped up to the transmission potential of 110,000 volts. The electrical energy at this voltage is transmitted along overhead lines to the various centres as required, at which points the pressure is stepped down to 13,200 and 4,000 volts for distribution to the various Municipalities where it is again stepped down to 550, 220 and 110 volts for general use.

The total route miles of 110,000-volt transmission lines at present number more than 430, and of other lines, operating at pressures of from 44,000 to 2,200 volts, there are about 1,800 route miles; in addition to these there are the lower voltage lines used, for general distribution within municipalities, the mileage of which is not known but must be very great.

The Commission is now serving about 250 cities, towns, and villages with power over an area nearly as large as that of England; about 5,000 hamlets and farms are also being supplied, a fact which is beginning to make rural life in this part of Canada more attractive than previously.

Although the Commission commenced operations by purchasing power and merely transmitting it in bulk, it now owns and operates a number of generating plants in various parts of the province.

In addition to supplying power, the Commission has a large purchasing department, which buys annually immense quantities of electrical and other materials in bulk, for sale to the municipalities at cost. An efficient laboratory is also maintained which makes electrical, physical, and mechanical tests on electrical plant, machinery, instruments, lamps, concrete, paint, oil, &c., as may be required.

Legal power has been assigned to the Commission enabling it to make and enforce rules and regulations for the proper inspection and control of electrical installation work inside buildings and in connection with outside overhead lines, &c., and a large staff of inspectors is now engaged in attending to this work.

The rates charged for power, lighting, &c., are under the control and regulation of the Commission in all the municipalities served by it, and all such rates are, it is understood, based on the fundamental principle that power be supplied at cost. Where a surplus is made, it is usually applied to extensions, &c.

Before the war the Commission organised a railway department, and a great deal of work has been done in making reports and surveys of several hundred miles of proposed electric railways. Owing to the war, however, this work has been largely held up.

At Niagara Falls the Commission has recently commenced work on one of the largest hydroelectric developments in the world. A canal about 12½ miles long is at present under construction running from some distance above the Falls to a point near Queenston, not far from the place where the Niagara River enters Lake Ontario. By means of this canal, not only will the head of water available at the Falls be utilised, but also the head which exists between the foot of the Falls and the level of Lake Ontario, which is nearly as much as that at the Falls. In this way instead of utilising somewhere about 150 feet of fall, there will be 305 ft. utilised, so that from the same water over 100 per cent. additional power will be obtainable.

The initial plant to be installed in the generating station near Queenston will comprise four of the largest hydraulic turbines yet built, each of them having a capacity of 52,500 H.P. Four electric generators of 45,000 K.V.A. capacity will be coupled thereto. The present canal will be large enough to enable a total of 300,000 H.P. to be developed, but the Commission has purchased sufficient land to enable additional canals to be constructed in the future, so that the total capacity will be 1,000,000 H.P.

* Cmd. 163. Price 6d.

At the present time the Commission has in view for future development within the province a total of 1,950,000 H.P. Of this quantity, the development of about 400,000 H.P. is already in sight.

**Developments in Quebec.** Outside the city of Quebec, in what may be described as the Quebec district, a wonderful development is taking place in connection with hydroelectric power. The Government of the Province, some years ago, adopted a policy of conservation and development of the water powers, their principal project being the La Loutre Dam on the Ste. Maurice River, which provides a storage reservoir covering 360 square miles, the largest reservoir in the world. With this as a guarantee of ample supply of water throughout the year, a number of manufacturing plants have been established at various points on the Ste. Maurice River, and electric power developed to the extent of over 200,000 H.P. at Shawinigan Falls, 130,000 H.P. at Grand Mere, 100,000 H.P. at La Tuque, 100,000 H.P. at Three Rivers, with a possible development at various points to total 830,000 H.P. in all.

There is no doubt that with the practically unlimited supply of power available for development in this province, the manufacturing of chemicals and other similar products should receive the attention of capitalists, now that the strain of the war has been removed.

This field is now being worked, and to a considerable extent controlled by United States' interests, but United Kingdom manufacturers of mill machinery and electrical plant would, in every probability, find it possible to secure quite profitable orders in these lines if they were prepared to compete for them.

**New Lines of Manufacture.** Among the classes of goods imported from Ontario prior to the war, and now manufactured there, may be mentioned steel for motor car frames, galvanised sheets, equipment for electrical furnaces, semi-rotary double acting pumps, steel plates, gear hoppers, machine tools, machinery of various kinds, alloys, electric bulbs.

**U.S. Branch Factories in the Dominion.** In a statement prepared by the Trade Commissioner, at the request of the Dominions' Royal Commission (see Minutes of Evidence, Part 1, pp. 415-418, Cd. 8,458), it was estimated, after an exhaustive inquiry, and a later revision of the results, that the United States had established in Canada over 500 branch works or assembling plants, large and small, representing an investment up to October, 1916, of £50,200,000. The greatest number of these branch works was in Ontario.

For some years past, until 1918, this movement slackened considerably. During the year under review, however, it was given a decided impetus by the renewed discussions of an Imperial preference. The United States manufacturer in many cases proposes to secure whatever advantages may be forthcoming in that direction, by erecting branch works in Ontario or in other parts of Canada, thus becoming, to all intents and purposes, a Canadian manufacturer. This is a matter which calls for the close attention of United Kingdom manufacturers, especially as the renewed activity along this line last year passed beyond mere discussion. Many inquiries were received by boards of trade, industrial commissioners and others from United States manufacturers in connection with the proposed establishment of branch establishments in this province. In several cases, definite agreements were signed by the municipalities and the industries interested. In other cases, the erection of branch works was actually commenced. At the time of writing there is every sign that an important development along the lines suggested will occur in this area during the next few years.

**Their Operation in Empire Export Trade.** A number of United States companies with branches in Ontario have been allotted by the parent concerns in the United States, export trade with various parts of the British Empire. This practice is likely to extend. In some instances, the branch industry in Ontario may later handle the entire export trade of the United States and Canadian companies. The tariff has an important bearing on this matter. Also should an order be placed, for example, by a public body in one of the Dominions, with the stipulation that the goods must be made in the British Empire, a United States company, in many instances, can have that order filled in its Canadian branch factory.

**United Kingdom Factories in Ontario.** There are several good reasons why it is not possible for United Kingdom firms to follow to a similar extent the example set by United States factories in establishing Canadian branches. At the same time, with the more intimate interest which is being taken by United Kingdom firms in this market, it is suggested that in some lines it may be found desirable at least to survey the field with a view to the advisability of establishing assembling or other works in this area to meet at closer range the competition offered. There are important factors to be considered. These are best known to the United Kingdom manufacturers themselves. In some instances, after a careful investigation of the conditions, it may be found that the policy of branch works here is unwise; in other instances, it may be discovered that the policy is the best one suited to the particular conditions prevailing.

Every possible assistance will be given by Ontario boards of trade, industrial commissioners, and municipalities to firms who contemplate the suggested action. Municipalities, in several instances, make substantial concessions to manufacturers building their works within the municipal borders, such, for example, as free sites, reduced taxation, exemption from taxation, cash bonuses, and water supply at low rates.

**Trade Organisations.** In the Dominion, as has been the case in the United Kingdom, war conditions have given an impetus to the better organisation of trade and industry.

Amongst new organisations which have been formed may be mentioned the Association of Municipal Electrical Engineers of Ontario, and the Canadian Electrical Dealers' and Contractors' Association.

**Import Trade in Metals and Machinery.** The abnormal conditions prevailing in the United Kingdom during the year naturally made it impossible for any business in volume to be done in the Canadian market. There is no good reason why the trade should not be resumed when conditions are again normal.

The principal developments in Ontario include an increased output of electrical furnace alloys, ferro-silicon, ferro-titanium, carborundum, and electric furnace steel. Ferro-molybdenum has also been produced. Larger quantities of brass and bronze have been produced and aluminium alloys and shrapnel bullets, which were not produced in Canada before the war, are being made.

In the sale of machinery our chief competitors have been the United States. In many lines, however, there are opportunities for better business, but it cannot be obtained unless adequate and persistent efforts are made. Electrical furnace equipment, previously imported from Switzerland, is now being made in Ontario at Welland, satisfying the demands of the domestic market in addition to securing export trade.

The machine shop capacity of the province has materially increased during the past few years as a result of war orders. Much of the machine equipment must now be turned into lines suitable for peace markets, and developments in these directions may be expected. Some of the machinery and supplies previously imported from the United States in large quantities will undoubtedly be made in Ontario, including, for example, small motors for motor boats, winches, and general deck work, plumbers' supplies, lead pipes, &c. As stated above, despite developments which may occur, there is room for the products of the United Kingdom, but a far more serious attempt must be made to obtain the business.

The end of the war is likely to witness a notable extension of the mining industry, especially in Northern Ontario. A number of companies have postponed developments or ceased operations altogether because of the high cost of labour, materials, and equipment. A large quantity of hoists, drills, explosives, hardware, motors, ball mills, tube mills, boilers, donkey engines, air compressors, concentrators, bucket hoists, steam shovels, belt conveyors, pipes, bar iron, sheet iron, &c., will be purchased. Competitors of the United Kingdom are already canvassing the situation with a view to obtaining orders at a later date from the mining companies for equipment.

**Electric Lamps.** The product of United Kingdom firms, according to large buyers locally, compares favourably with any of the lamps made on the American continent. The principal competition is from the United States. The Canadian production is considerable, there being six factories in this area. Japanese competition was aggressive, but the quality of lamps is poor. Only one electric bulb manufacturer is established in Canada, the works being at Toronto. All styles of electrical bulbs are made in these works, which have taken up this line of manufacture during the last three and a half years. Carbon, tungsten, and nitrogen lamp bulbs are turned out in sizes running from two candle-power to 1,000 candle-power. About 35,000 bulbs a day are made, and this is approximately, it is said, equal to the needs of the trade.

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**Motor Trade Research.**—The Research Association of British Motor and Allied Manufacturers is now in course of formation, and firm promises of support have already been received from a large number of the leading firms. The research association has been formed as a result of negotiations between the Association of British Motor and Allied Manufacturers and the Government Department of Scientific and Industrial Research, and is the first approved association of this sort representative of any section of the engineering industry. The research association will be governed by a council, which will be assisted by a committee of research. The latter will be wholly constituted of technical men possessing high qualifications, and the technical side of the industry will also be strongly represented on the council of the research association. In this way it is hoped to establish a closer relationship between the technical and commercial sides of the industry, and to bring about more complete recognition of the importance of applied science. The work of the research association will fall naturally under two heads, *i.e.*, research proper and the collection and organisation of scientific information bearing upon all questions which may subsequently become the subjects of research.—*Financier.*

## NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

15,070. "Electric switches." J. B. Tucker & Tucker & Co. June 16th.

15,080. "Controlling and regulating systems for dynamos applicable as motor starting systems. W. J. Ricketts. June 16th.

15,081. "Electrical signalling apparatus for ships, &c." W. Burwell, R. P. Myers and E. Itterson-Pronk. June 16th.

15,085. "Regulating systems for alternating current circuits." British Thomson-Houston Co. (General Electric Co.) June 16th.

15,087. "Current limit relays." British Westinghouse Electric & Manufacturing Co. June 16th. (U.S., June 21st, 1918.)

15,106. "Lock out switches." R. P. Bosson, V. Bekeze and A. West & Co. June 16th.

15,112. "Brush holders for dynamo electric machines." C. M. Owen. June 16th.

15,116. "Electric switches." Benjamin Electric, Ltd. June 16th. (U.S., September 13th, 1918.)

15,132. "Electric chain welding machines." G. J. Armstrong. June 16th.

15,140. "Electric engine starting device." S. T. Henn & Rushmores, Ltd. June 16th.

15,192. "Electrical terminal." T. N. Coventry & L. Karno. June 17th.

15,208. "Machines for armouring electric wires and cable." Fullers United Electrical Works & A. P. Welch. June 17th.

15,229. "Detecting impulses or waves communicated by radiant energy." M. Compare & Comparri Wireless Control Syndicate. June 17th.

15,232. "Commutators or current distributors for internal combustion engines." C. S. Snell. June 17th.

15,251. "Method of electrically treating steel, &c., and hardening same." W. H. Readett. June 18th.

15,269. "Clips for supporting and fixing electric cables, &c." Jones Bros., E. Jones, T. S. Jones and W. A. Mortimer. June 18th.

15,270. "Junction boxes for electric cables." Jones Bros., E. Jones, T. S. Jones and W. A. Mortimer. June 18th.

15,274. "Method of making connection to cathode heated by alternating current. J. Scott-Taggart. June 18th.

15,275. "Self-aligning electrical fuse handles." Bash & Russell and D. S. McNeill. June 18th.

15,276. "Constant voltage dynamo." P. T. White. June 18th.

15,278. "Constant voltage dynamo." J. Enderson. June 18th.

15,280. "Electric switches." M. Compare & E. Pizzi. June 18th.

15,301. "Electric voltage regulator." British Thomson-Houston Co. (General Electric Co.) June 18th.

15,317. "Electric irons, &c." Electric Heating Co., G. A. Hughes. June 18th.

15,335. "Means for mounting electrodes in steam boilers, condensers, &c." A. S. Gush. June 18th.

15,341. "Electrical coils." Igranic Electric Co and S. R. Wright. June 18th.

15,342. "Method of indirectly coupling radio-telegraphic antenna to high frequency transformer." J. Bethenod. June 18th. (France, March 15th, 1918.)

15,344. "Repair or renewal of electric incandescent lamps." F. Harrison. June 18th.

15,351-2. "Telephones." R. L. Murray and Telephone Manufacturing Co. June 18th.

15,360. "Coupling for electric conduits, tubes, shafts, &c." H. E. Hadwin and H. Willis. June 19th.

15,380. "Device for underground or surface signalling." W. J. Sells. June 19th.

15,382. "Electrical signalling apparatus for mines, &c." I. H. Parsons and H. R. Waddington. June 19th.

15,402. "Switch and fuse contacts." F. R. Fletcher. June 19th.

15,430. "Control for electric furnaces, &c." British Thomson-Houston Co. (General Electric Co.) June 19th.

15,445. "Sparking plugs." M. Parson and R. Wellesley. June 19th.

15,447. "Measurement of alternating electric current power." Ferranti, Ltd., S. Z. de Ferranti and G. Wall. June 19th.

15,448. "Device for testing electrical ignition of internal combustion engines." T. A. Nayler. June 19th.

15,451. "Contact pins for connecting plugs." O. O. Kring and O. Stalhane. June 19th.

15,474. "Electro magnet." G. C. Cummings. June 19th.

15,476. "Combined electric lamp and alarm clock." N. A. L. Neilson. June 19th. (Denmark, July 3rd, 1918.)

15,480. "Ignition attachment for prevention of theft of motor vehicles." T. A. Kirton. June 20th.

15,491. "Electric charging station." G. F. R. Turner. June 20th.

15,508. "Electrical measurement of liquid." F. G. Dunn. June 20th.

15,516. "Electrodes in vacuum tubes." J. Scott-Taggart. June 20th.

15,521. "Electricity collectors." J. W. Astley and British Insulated & Helsby Cables, Ltd. June 20th.

15,528. "Means for distributing spark in multi cylinder internal combustion engines." G. M. Blackstone, E. Carter and F. Carter. June 20th.

15,531. "Vacuum tube rectifiers of alternating currents for wireless telegraphy." J. Scott-Taggart. June 20th.

15,532. "Method of cooling electrodes in vacuum tubes for wireless telegraphy." J. Scott-Taggart. June 20th.

15,533. "Electric dry batteries." Efandem Co. and A. Hooper. June 20th.

15,544. "Electric switches." F. M. Burrell and C. W. Smith. June 20th.

15,554. "Magneto couplings." C. Pether. June 20th.

15,555. "Automatic signal buoy and wireless transmitter mechanism thereof." W. E. Sansom. June 20th.

15,556. "Amplification of electric currents." British Thomson-Houston Co. (General Electric Co.) June 20th.

15,574. "Electricity meters." J. N. Chaviara and J. F. Gill. June 20th.

15,596. "Electric rail bonds, &c." J. Mather. June 20th.

15,610. "Electrical water heater." J. F. Barr. June 20th.

15,621. "Terminal electrical connections for sparking plugs of internal combustion engines." M. L. Williams. June 21st.

15,643. "Trolley pole reversing mechanism for overhead electric tramways, &c." J. R. Cooke. June 21st.

15,654. "Electric plug connecting devices." R. W. Blades. June 21st.

15,658. "Sparking plug for petrol and gas engines for motor cars, aeroplanes, &c." A. Greensmith. June 21st.

15,662. "Electrical switch." A. J. Hesler and J. Sanderson. June 21st.

15,668. "Trip mechanism for electric ignition devices for internal combustion engines." A. J. Adams. June 21st.

15,693. "Control device for contacts of electric bells." B. A. L. Hasselberg. June 21st.

## PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

### 1917.

5,262. Variable Inductances. A. H. Bagnold, S. Johnson and F. G. Goldstone. April 13th, 1917. (127,313.)

5,360. Electrodes for electric arc soldering. E. H. Jones. April 13th, 1917. (127,315.)

5,363. Audion or lamp relay or amplifying apparatus. M. Latour. April 15th, 1916. (127,318.)

5,411. Magneto or dynamo electric machines. Soc. Anon. De Magnetos & Appareils Electriques Sama. May 17th, 1916. (127,319.)

5,519. Wireless signalling systems. British Thomson-Houston Co (General Electric Co.) April 19th, 1917. (127,325.)

5,739. Wireless signalling systems. British Thomson-Houston Co. (General Electric Co.) April 24th, 1917. (127,335.)

7,392. Sound-detecting devices. Sir T. Wrightson, J. M. Ringuist and Head, Wrighton & Co. June 4th, 1917. (127,347.)

### 1918.

2,970. Electric steel manufacture. V. Stobie. February 20th, 1918. (127,066.)

4,759. Interrupters for use with ignition systems and dynamos. E. C. R. Marks. (Splitdorf Electrical Co.) March 18th, 1918. (127,068.)

6,727. Glands for electric cables shafting and the like. W. G. Wheeler. April 20th, 1918. (127,076.)

6,811. Electrical testing apparatus. J. MacFadden and E. W. Adams. April 23rd, 1918. (127,078.)

6,978. Telephonic systems. E. A. Graham and W. J. Ricketts. April 25th, 1918. (127,366.)

7,037. Apparatus for reproducing in ordinary characters messages or intelligence received as electric impulses or in the form of perforations in a tape. Creed & Co., A. J. Polley and F. G. Creed. April 26th, 1918. (127,367.)

7,045. Apparatus for performing work of short duration at predetermined times such as automatically operating electric switches, gas and water valves, and the like. J. Gray. (Warren Clock Co.) April 26th, 1918 (127,368.)

7,616. Telephone and the like apparatus. A. T. Thomson and A. James. December 7th, 1918. (127,375.)

8,162. Galvanic batteries. G. Oldham and J. Oldham. May 15th, 1918. (127,376.)

8,331. Conductors for electric current. C. O. Bastian. May 17th, 1918. (127,066.)

8,334. Dynamo electric machines. Portable Electric Motors, Ltd. & G. Fryer. May 17th, 1918. (127,088.)

8,581. Trolley heads for electric tramways or the like. Wadkin, Mills & Co., A. G. H. Thatcher & J. G. Small. May 23rd, 1918. (127,102.)

8,644. Dynamo electric couplings. A. Gossweiler. May 20th, 1917 (116,286.)

9,282. Ignition systems for internal combustion engines. A. H. Midgley C. A. & Vandervell & Co. June 5th, 1918. (127,121.)

9,454. Electric safety lamps. Fuller Accumulator Co. and A. P. Welch. June 8th, 1918. (127,417.)

9,980. Electric lock out switches. Igranic Electric Co. (T. E. Barnum and W. E. Date.) June 27th, 1918. (Patent of addition not granted.) (127,426.)

10,183. Electric furnaces. A. E. White. (Industrial Electric Furnace Co.) June 20th, 1918. (127,131.)

10,412. Electro magnetic wave transmission. B. Binyon. June 24th, 1918. (127,434.)

10,650. Devices for placing trolleys on to overhead conductors of electric tramway systems. W. H. Gamble. June 28th, 1918. (127,438.)

10,728. Sparking plugs. F. N. Goodson and J. H. Fenwick. June 29th, 1918. (127,136.)

10,858. Electrically propelled trucks and like vehicles. P. A. H. Mossay and Mossay & Co. July 2nd, 1918. (127,441.)

11,476. Trip or accelerating mechanism for magnetos and for other purposes. Bosch Magneto Co. September 21st, 1917. (119,444.)

13,024. Electric furnaces. T. Rondelli. August 10th, 1918. (127,458.)

13,090. Regulating apparatus for electric supply systems. Soc. Anon. des Establissements L. Bleriot. November 23rd, 1917. (120,877.)

15,602. Ignition systems for internal combustion engines. P. C. Rushen. (General Motors Corporation.) September 25th, 1918. (127,483.)

15,944. Electro-plating steel articles. British Thomson-Houston Co. (General Electric Co.) October 1st, 1918. (127,177.)

17,242. Attachment of telegraph wires to the insulators of telegraph poles and like supports of aerial wires. W. A. Davis. October 22nd, 1918. (Addition to 3,478/18.) (127,487.)

17,319. Machine for the generation of electric currents, also applicable as a motor. A. Young. October 2nd, 1918. (Divided application on 14,538/17.) (127 188.)

18,054. Electric snap switches. Edison Swan Electric Co. & F. Shergold. November 4th, 1918. (127,186.)

18,590. Attaching means for electric fixtures. F. D. Parmenter. November 13th, 1918. (127,495.)

18,891. Electrical heating and cooking apparatus. C. G. Nobbs and W. W. Nobbs. November 18th, 1918. (Addition to 12,318/15.) (127,496.)

19,311. Electrical switches, starters and controllers. R. H. Barbour & H. R. C. Partridge. November 23rd, 1918. (127,194.)

21,018. Armature cores. Bushnell Magneto Co. and J. B. Bushnell. December 17th, 1918. (127,510.)

21,407. Apparatus for electrically controlling railway signals. A. Monard. May 28th, 1918. (Addition to 21,298/18.) (127,514.)

### 1919.

9,178. Electric motors. Portable Electric Motors, Ltd., & G. Fryer May 17th, 1918. (Divided application on 8,334/18.) (127,227.)

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**Strikes.**—The Canadian authories have begun deportation proceedings against the ten strike leaders arrested last week, who are charged with treason. It is understood that the strike at Winnipeg is crumbling, and that the city is assuming normal conditions. A limited tramway service came into operation last week. Tramway workers at Toronto have struck work for a wage of 55 cents per hour and an 8-hours' day. The Railway Employés' Federation has passed a resolution, at Calgary, urging a general strike to secure the release of the Winnipeg labour leaders.

The Australian troubles continue, and much distress is resulting; a serious fuel shortage is feared.

In Italy strikes continue, and collisions resulting in casualties have occurred between the military and demonstrators.

The French labour conditions are now much easier, and strikes have ended.